THE SUBMARINE REVIEW

JANUARY 1988

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FROM THE PRESIDENT

Greetings! I wish you and the Naval Submarine League a productive and prosperous 1988.

I have several items of good news to relate. First, the NSL and the DCNO (Subs), VADM Bruce DeMars, USN, have agreed to the concept of a classified Submarine Technology Symposium. This event is structured to provide a forum for the technical experts in the fields that are relevant to future submarines to present their work to their peers and, in the process, stimulate the entire community toward technological advancement. The Symposium will be held in early June, 1988 at the Applied Physics Laboratory, Johns Hopkins University in the Laurel Maryland facility. APL/JHU personnel will play a major role in the organization and support of the symposium. Several ground rules apply.

a. The Symposium will be self-sustaining through registration fees, without cost to the government.

b. No on-going Navy Programmatic topics are acceptable as agenda items.

c. The Symposium will be held at the Secret level.

d. Corporate attendees should be directly involved in the IR&D process to be able to establish their "need to know".

e. Attendance will be by invitation.

Current NSL Corporate Members and Navy facilities will be contacted by letter to solicit their prospective attendees. Those other NSL members who are employees of Corporations not currently an NSL Corporate Member may request an invitation by writing to:

Jill Owens, Room 8-368
Applied Physics Laboratory/JHU
Johns Hopkins Road
Laurel, Maryland 20707

Please provide a description of your current corporate assignment to help establish your eligibility for attendance.

This Symposium is an extremely ambitious undertaking for the NSL; however, it should result in time, with answers to the often heard question of "where does the submarine force feel corporate IR&D should be emphasized?". VADM "Bud" Kauderer, USN(Ret.), has been designated the SUBTECK Symposium Chairman for the NSL. Good luck, Bud! This is an awesome responsibility.

Second, we have received Corporate funding pledges sufficient to enter definite discussion for the production of an hour-long PBS documentary entitled "Submarine Patrol." It has been about 17 years since an authoritative documentary has been produced for the submarine service. When completed, edited copies of the documentary will be provided to the Navy for recruiting and educational purposes. Copies will also be provided to NSL Chapters for their Public Affairs Program. Finally, copies will be available for sale.

This project is also an ambitious one, but it is a very exciting undertaking. It should help focus the public's interest on the submarine service as the submarine's role in national defense is becoming more vital.

Finally, I would like to announce for our individual members that two-thirds of your annual dues have been determined to be tax-exempt. A certain portion (1/3) has been deemed to have been returned to each member in the form of informational material. Our treasurer, Jason Law, can answer your questions if needed.

In summary, I feel very optimistic about the NSL for 1988, and the fulfillment of its mission and objectives. Occasionally I am disappointed

when a former NSL member states that the NSL is not doing enough for the individual. I always hasten to remind these individuals that the strength of the NSL is the sacrifices and dues each member makes to help the NSL successfully accomplish its mission. I firmly believe that the NSL is a great investment and something to be proud of.

Shannon

FROM THE EDITOR

The Submarine Force has been directed to carry out R&D programs which will hopefully improve our nuclear submarines in the next decade. Additional money has been budgeted by the House Appropriations Committee for FY'88 over and above the Navy's submarine R&D request -- for specific areas of submarine R&D such as boundary layer control, compliant coatings, hull technologies, advanced propulsion systems, automation and advanced materials. This money is designed to ensure that the Navy makes a good effort to incorporate some of the developed new technologies into the submarines of the 1990s.

The Congress evidently believes that the Navy's requested submarine R&D programs have not reflected the potentials of certain technologies which can markedly improve our U.S. submarines. It may be noted that large sums of submarine R&D money have been spent and are still being budgeted for improvements in the areas of: more capable sonars (wide aperture arrays); a new fire control system (SUBACS); and an improved power plant (using a pressurized water reactor). For the technology areas specified by the Congress, moreover, there has been some R&D money used. But seemingly, such technologies -- as indicated by the limited expenditures on them -- are thought to

offer little prospect for improvement of U.S. nuclear submarines.

This is understandable within the context of the single-hull U.S. submarines which have been produced over the past twenty years and duplicated in the new SSN-21s.

The Congress however, has been regarding the Soviet technological advances in nuclear submarines and have been led to believe that the Soviets are producing better submarines with many superior capabilities -- in depth, speed, survivability, non-acoustic signatures, ratio of power plant weight to horsepower generated, automated control systems, etc.

But the Congress has seen these Soviet advances in the context of double-hulled nuclear submarines -- which our submariners have felt were too expensive to build for the capabilities they offer, and "they're too noisy for our use -- which depends on quiet-covertness and superior acoustic capability to meet our mission requirements." A greater Soviet depth capability is similarly considered to be of little value because "our" torpedoes can go deep and destroy the deep-diving Soviet submarines even while our own submarines are restricted to far shallower diving positions. The survivability built into Soviet submarines (reserve buoyancy, heavier hulls, compartmentation, etc.) is also felt to be of little value, because "even a small leak 'at depth' will do in any submarine." Hull drag reduction measures (compliant coatings, etc.) are, it is felt, compensated for, at less cost, by using more powerful nuclear power plants. And, greater Soviet submarine speed is thought of little value because our submariners are certain that it is only "quiet high speed" (not maximum speed) which is of particular tactical value. However, these arguments appear to be specious, particularly to the Congressional staffers.

Interestingly, high speed can be obtained by drag reduction as well as by increased engine horsepower. A 30-knot submarine, for example, can be made to go 38 knots by doubling its propulsive power, or the same 30-knot submarine could make 38 knots by halving its drag. It would seem that to the Congress this must be a better way to achieve greater speed in our submarines -- as evidenced by their list of R&D projects to be explored. Since many drag reduction measures appear to be more compatible with double-hull construction, it is felt that such submarines of lesser drag and smaller power plants should consequently be lighter, and smaller with more usable volume than single-hull submarines or if not smaller have superior qualities in most respects -- and possibly be of less cost.

For those who see the Soviet submarine design advances as providing a measure of superiority over U.S. submarines, it is evident that the arguments put forward for single-hull submarines must be questioned. Apparently the Congress intends do that.

There are many more possible advantages in going to double-hull submarines which might not have been equated in trade-off analysis between single-hull and double-hulled submarines. For the double-hull submarine the pressure hull can be of simpler shape with less design problems, and more easily given great depth capabilities. It could have external stiffeners -- giving greater usable interior volume. It can more easily provide reserve buoyancy through external tankage. It can provide reduced non-acoustic signatures, notably through external degaussing coils, etc. It can have external stowage of weapons and ceramic armor tacked on to the inside of the outer hull for dissipation of shaped-charge energy. It can allow the bow planes to be folded into the space between the outer and inner hull. The outer hull can be molded into laminar flow shapes -- as evidenced by

the coke bottle shape of the VICTOR III submarines. It can more easily be configured for new kinds of missions (for berthing of midget submarines, support of underwater swimmers, use of remotely operated vehicles, etc.), and perhaps most importantly it can incorporate drag reduction measures which are virtually impossible to apply on single-hull submarines.

In addition, the Navy's argument that little can be done to improve our 1990's fleet of 688-type submarines seems also open to question. The Congress, moreover, has significantly called for expenditures of money to investigate this. Henry Payne's article in this issue of the SUBMARINE REVIEW seems to deal with an area which might be improved in the 688s. And the Congressional push to have the Navy realize a satellite-to-submarine laser communication system would be another technology for improvement of our attack submarine fleet of the '90s.

The Navy is being challenged by the Congress to prove that single-hull submarines, progressively bigger in order to be better, are the direction for future submarines. The question is, how is this done convincingly?

A SUBMARINE OPERATIONAL TACTICAL SYSTEM

A confluence today of many military technologies, international political relationships, emerging sea threats, and joint military interdependencies indicate that in order to further our national security, our submarines must be an important part of joint (or combined) operations at sea. (The Air Force and NATO navies may join this system.)

In particular, the surface battle groups which are an essential element in the U.S.

Maritime Strategy are becoming increasingly vulnerable to enemy airborne and submarine threats and have a great need for submarines to augment their composition. As utilized today, submarines will provide a form of "associated support" to battle groups through distant picket-type operations -- sweeping the oceans more than one hundred miles out ahead of a battle group to eliminate or divert enemy submarine or surface threats from the battle group's main elements.

The antisubmarine function of U.S. submarines is well understood while the antisurface ship function -- using TOMAHAWKS or HARPOONS -- is just emerging. In the near future, an antiair capability (including destruction or diversion of enemy missiles in their trajectories) is likely to develop as an additional supporting submarine function. Moreover, the high speed of U.S. nuclear submarines -- well in excess of a battle group's maximum speed -- and their high "quiet" speed, as well as their great stealth and the considerable firepower of their missiles and torpedoes with high PK's, increases the requirement for submarines in order to reduce the vulnerability of battle groups in today's warfare environment.

The joint operational tactical system (JOTS) which is the subject of this article is basically a micro-computer "battle management" system. This system, requiring 4.5 megabytes of random access memory and 55 plus megabytes of hard disc storage capability, consists mainly of programs integrated in an existing shipboard computer -- in most cases in the Hewlett Packard 9020 computer. It has also been tried in the HP 9050s and 850s. The system is installed on many surface combatants and in fact is on all surface units of the battle group containing the attack carrier SARATOGA. It is also installed in supporting ship and shore based command centers, at certain Navy intelligence sources and at meteorological centers. It is not

yet installed, however, in aircraft which might support a battle group, e.g., AWACS, E-3s. E-2Cs or P-3s. Nor is it in submarines, although it has been experimentally tried in a Sublant submarine.

What this tactical desk-top, micro-computer system offers is graphic geographical information, contact or target information and their tracks, and near real-time meteorological data for battle areas under consideration. Target information from possibly several battle group sources correlated with programmed enemy intelligence and other data base information can provide coordinated fire control decisions within a battle group and offer the tools for current or long term operational planning.

In dimensions, a stand-alone, joint operational tactical system would require about 3x3x4 feet of micro-computer volume and include a 13-inch display screen -- if not housed in an on-board HP 9020.

The joint tactical systems for a battle group and its supporting activities are tied together by mainly Link II or Link 14 communications along with direct satellite communications -- communicating securely with each other while exchanging tactical and firing data and sharing a Red, White and Blue picture (Red for enemy, White for non-combatants, and Blue for friendlies).

Why should this joint, tactical computer battle management system be introduced into a submarines's HP 9020 all purpose micro-computer?

First, submarines are expected to be an integral part of a battle group, even if only in the associated support role. Second, since the SSNs with a battle group will play an increasing antisurface role, and possibly an antiair and outer air-battle role, an increasingly tight integration of effort appears to be required.

Basically, this joint tactical system involves automated data entry to each unit's computer. In the case of submarines, it builds on the data supplied by the Submarine Fleet Mission Program Library. A strength of this system is its use, to control from start to finish, any attack involving the battle group, even when changes are made while the attack tactics are in progress. A cruise missile attack, for example, against an enemy surface group, can be monitored by all units on their real-time screen presentations -- with continuous updating of enemy target data from any part of the system, including satellites. This makes possible close coordination of missile strikes, inflight correcting and retargeting of missiles, missile avoidance of friendly forces, and possibly battle damage assessment -- making re-attack decisions feasible in a matter of minutes. Gridlock problems for this system are already solvable through utilization of NAVSTAR (or TRANSIT) geographic positioning, generated by a calculation from a single global positioning satellite. (Five GPS satellites are presently in orbit with more coming on line shortly, thus providing a 24-hour-a-day capability.) Importantly, to make TOMAHAWK attacks by a submarine most effective, the joint, real-time contributions of third party sources appear to be essential.

With this joint tactical system in operation, a submarine: (1) will quickly know when a submarine contact that has been classified as an "enemy" by any part of a battle group, is actually a friendly member of the group and (2) will have the tools to take rapid action to prevent any mistaken attacks.

It should be noted that less of the "stealth" of the supporting submarines is compromised with this automatic tactical system in operation. The need to remain as covert as possible in playing the antisubmarine role is recognized, and this system helps this basic principle of submarine

operations by collecting and keeping updated a tactical picture which can be readily dumped to a submarine either via the Shore Targeting Terminal (STT) or directly.

This joint tactical computer system is ideal for independent submarine operations, as well as for employment with battle groups, since it reflects a best picture of friendly, non-combatant and enemy forces as compiled by a fleet commander. This would tend to minimize the chances of a submarine's normally generated plot neglecting to include some of the surface and air contacts in the area under the submarine's consideration.

Bert Findly

COMPUTER LITERACY FOR SUBMARINERS

Give submariners the opportunity to get hands-on personal computer training at sea! How? Provide each submarine with one or more small desk top computers like the Zenith Z-248, that crew members can use on their off-time for their own training and productivity. Let them experiment with standard software packages like WordPerfect, Lotus 123, and dBase III. Soon they will be teaching themselves the programming language of the Disk Operating System (DOS) in order to write their own programs. (Self-paced video cassette courses are also available.)

It is predicted that, given the opportunity, submariners will quickly learn to use a personal computer of under $2,000 cost to produce programs that will benefit the ship as well as themselves. The possibilities are many.

Exercycles and rowing machines have been put on board submarines -- without specific orders to use them. Those who do use them are benefited. Surely there are a few in the crew who want to

develop an expertise in the use of computers. They see the handwriting on the wall -- that personal computers will become as indispensable as the typewriter and telephone.

Only about 25 years ago the IBM selectric typewriter was introduced. Now the typewriter is relatively obsolete -- being frequently replaced by word processors and personal computers. Just look around any modern office -- monitor screens are everywhere.

Within the Naval Sea Systems Command the Submarine Directorate has over 300 Zenith Z-248's with an assortment of laser printers, operational programs, and desktop publishing programs -- for use by NAVSEA activities. A dedicated computer training facility for the directorate is located in a NAVSEA building which demonstrates the utilization of the personal computer. And, the tools for amassing data, relative to submarine acquisition and maintenance management have been provided -- which previously were too voluminous to manipulate by any number of people. Additionally, the SSN 688 class and SEAWOLF class submarines are being pursued as lead weapon systems for the demonstration of major elements of computer-aided logistics (CALS) -- an integrated mechanism for a modernization process that is underway in the Navy today. Programs exist or are under development for automating offboard logistics technical information, and introducing advanced computer technologies to specific logistic functional applications. One of the foremost purposes of CALS is to integrate these programs for enhanced weapons systems acquisition and support.

Becoming literate on computers aboard can prepare submariners to be useful in shore jobs involving such computer assisted programs. And, the same sort of things can be done for shipboard problems and are likely to be programmed by enthusiastic crew members who want to demonstrate

their acquired computer skills. They are likely to automate their needs: record keeping, personnel actions, duty rosters, recall lists, maintenance records, turnover documentation, publication status, qualification programs, chart lists, work packages, advancement requirements, check off lists of reports required, patrol report inputs, training requirements, etc. When they have the mundane problems automated they should ascend into tactical, operational, and engineering analyses.

Most importantly, computer-literate resourceful submariners are likely to develop programs which should markedly reduce the on-board paper work overload -- so crippling to important at-sea training programs.

Classified data may be worked on the computer's hard disk as long as it is not permanently stored there. Programs are available to insure the hard disc is erased of classified data after each use. (See your classified material control officer for specific guidance.)

Crews provided with personal computers might be tasked with specific problems: budget requirement analyses, coordinated logistic deployment analyses, torpedo doctrine analyses. The list of projects is great. The capability and curiosity of submarine sailors is also great. Their computer-oriented talents should not go to waste. They should be computer literate to advance their professionalism and to make them more productive ashore. In the end, the submarine force will benefit.

Captain Alfred A. Ortlieb, USNR
Lieutenant Walter M. Locke, Jr., USNR
COLUMBIA RESEARCH CORPORATION

NEW SUBMARINE CONCEPTS

The Navy has talked for several years about the Maritime Strategy. This has certainly been advantageous from the point of view of force building and for trying to articulate what should be done to support the Navy. Unfortunately in today's fiscal environment, with a flat or descending budget, you have to moderate the programs that are in place. In order to defend these programs, you tend to lose your ability to look ahead. Based on my last two years in the government and my two years outside of the government, I have formed the opinion that it is almost impossible to put together a forward looking program because of the zealous oversight from those in the Pentagon and on the Hill. There seems to be a view that new programs imply that the current programs have a problem.

The current Navy submarine program represents not only an assured strategic deterrent, but should represent an assured tactical deterrent. A lot of you believe that, but you have to give the submarine force the tools to perform this function. What can be done is suggest ideas to help support this idea.

The SSN-21 is long overdue. The Submarine Community is clearly the best organized of the various parts of the Navy and has excelled in clearly articulating their current course. The recent strong defense of the SSN-21 has resulted in a program that is clearly going forward -- but it has not been without a lot of trauma. The historical reluctance to start new submarine classes is replete with many studies, all sorts of discussions, and all kinds of budget cuts. The starting of a new program was complicated by the submarine force itself. The complicating factor was the success of the 637/688 Classes. It is hard to get people interested in developing a new submarine when the rest of the Navy is hurting so

badly. This was compounded by skippers coming back from patrols with great successes. Thus it was hard to convince others that we needed a new program. The Soviets, however, have made the case for us. They have continued to build submarines at a tremendous rate. As a matter of fact, their submarine program currently looks like the program the United States had back in the days before the 637 Class. We built several hulls, and propulsion systems. Finally we settled on a design that we committed to production resulting in the 637 Class first, followed by the 688 Class. In the meantime, the Soviets continued to move ahead with new designs. While their actions provided us an opportunity to respond, and the SSN-21 is clearly that, the U.S. has been put in a reactive mode by the budget process. So now is the time to take bold new thrusts to maintain preeminence in submarine warfare.

What I will describe are strictly a series of ideas. They clearly need significant debate without penalties to the people presenting them, or without people being upset about new ideas being invented that perturb current concepts. To best examine these ideas what is needed is an effort along the lines of the STRAT X Study that took place before the TRIDENT Program got started. We can only pursue a few new things on top of the current programs. No matter how ambitious, and how wonderful it would be, I don't believe that any rational budget process will allow us to pursue more than a few new ideas at a time.

There are two separate areas that might be considered. The first one is the addition of off-board devices to support submarine ops. The second one is more controversial -- new platform concepts. I will refrain from suggesting underwater aircraft carriers and discuss briefly the few ideas that appear to have merit.

Starting with off-board devices, tethered and

untethered devices for sensing, communicating, and for providing standoff weapon capability are all possible. Fortunately new technologies are here now and are coming along which will allow these things to happen. Foremost among these are fiber optics. They represent a huge step forward in terms of tethers and sensors. They are lightweight, strong, they have high bandwidth, and they are relatively inexpensive.

The other major technology that most of you are familiar with is VHSIC (Very High Speed Integrated Circuits). They represent an opportunity to do an enormous amount of processing and also will become the host for the kind of smarts that will be required for off-board sensors of all types.

The first off-board concept (figure 1) would be a tethered or untethered, underwater, unmanned vehicle. This device could be used for a large number of missions ranging from a decoy to an off-board sensor system. Communications could be by any of several methods: direct fiber optic tether, buoy to aircraft or satellite or buoy to buoy if the distances were not too great.

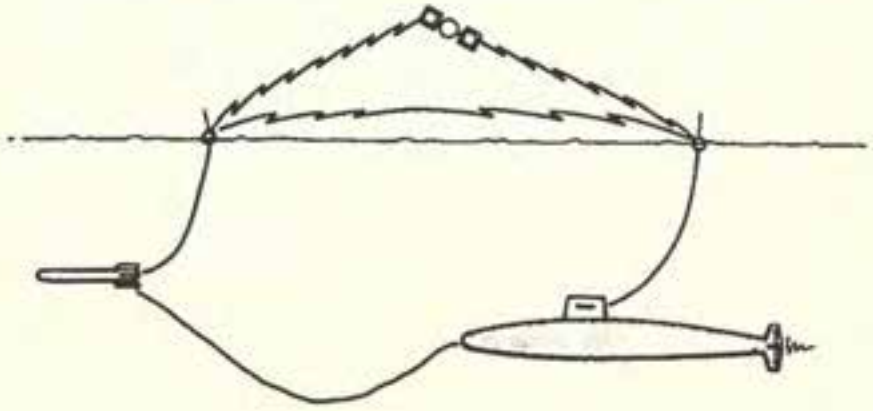

Figure 1

Propulsion options for off-board devices are also coming along with things like lithium thionyl chloride batteries and other types of devices. It is clear that these types of devices will provide the submarine force with a tremendous complementary capability -- allowing our submarines to maintain an advantage over whatever adversary that will evolve.

The capability depicted in Figure 2 is more debatable. The submarine force now has a new weapon system for sea and land attack, TOMAHAWK. TOMAHAWK is designed to do a number of things; for example, to sink ships. Clearly the land-attack TOMAHAWK is designed to go inland and destroy harbor facilities and ships in port. The problem that submarines always have had was knowing the location of distant targets and what happened to them after an attack with over-the-horizon weaponry. This represents a tremendous problem. Clearly what we need is a Remotely Piloted Vehicle (RPV) to provide targeting and battle damage assessment. There is no question that utilizing RPVs from submarines is within the state of the art. If you can shoot a HARPOON or TOMAHAWK out of a submarine, you can certainly shoot an RPV. What this figure tries to depict is that such an RPV could be launched through a torpedo tube and data retrieved through a buoy. Or, I believe you could fire an RPV and have it feed out fiber optic cable and have it linked directly back to the submarine without a sea buoy. This is an exciting concept, and as we move forward with the SSN-21 with its large payload, this concept will give an already stealthy platform in the Navy an added dimension in terms of forward operations.

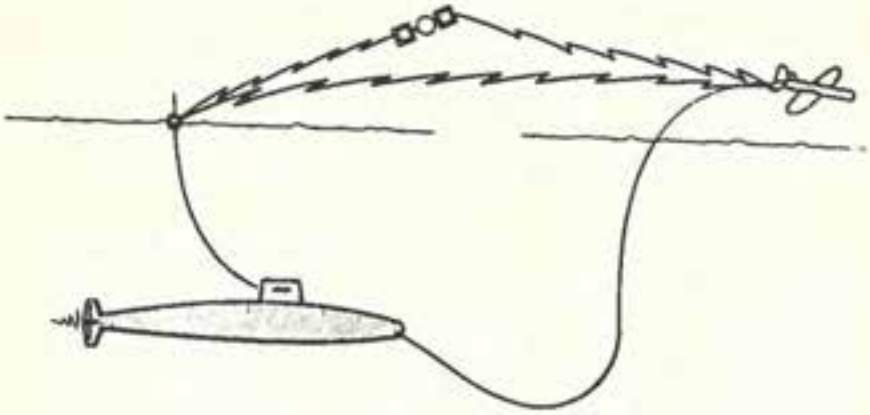

Figure 2

Another area which deserves some comment is communications. Communications could become the Achilles heel of the overall ASW problem -- not just for submarines. The submarine force has the potential to improve submarine communications with the submarine Laser Communication Program. It has tremendous merit, and I believe that with some innovation, up-link concepts could be developed that would provide a two-way capability. This would really improve the potential for submerged, wide-bandwidth communications.

Now as to some new platform considerations, it should be recognized that there is a widely held belief that the submarine force is capped -- 100 SSNs plus the SSBN force. Over the last several years, outside interests have suggested that we could have more submarines by substituting some number of SSNs with diesels at a 3:1 ratio. But the submarine force has rightfully believed that in the end they would still only have 100

submarines. They have fought that issue correctly and have not allowed themselves to be beguiled by the idea that if they give up 10 SSNs, they would get 30 diesel boats. And I'm not sure what you would do with those diesels if you had them.

In the context of this thrust to consider new ideas, however, it should be kept in mind that the 100 submarine SSNs are fenced and the three new ideas presented here are not intended to be a replacement for anything in the current force.

First of all, there should be a submarine that can be used for R&D of all types. For maximum flexibility a double hull submarine looks attractive. The pressure hull could be modified and smaller in diameter, it would certainly be a survivable submarine, well compartmented and configurable to do whatever mission you want, and you would have space between the hull for various items. The outboard configuration could optimize hydrodynamic shaping for the outer hull (figure 3).

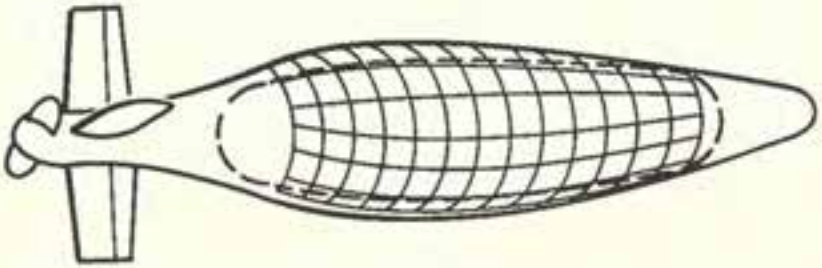

FIGURE 3

The outer hull would also present a great opportunity for a large hydrophone farm. If we could build a submarine with sufficient outside area, and take advantage of hydrodynamic shaping it should be quite a detection platform. We certainly should try to build a submarine that could be used as a test bed. Incidentally, the reason I bring up the double hull issue as we get into off-board devices and sensors is that the area between the hulls would make a fine storage area. The initial basis for the propulsion could be a derivative of the SSN-21.

What is being discussed is a true R&D submarine. While we were debating the ACSAS program a few years ago, we were really stymied by the lack of an R&D hull. The potential benefits of such a submarine and its configuration needs to be recognized.

The second platform mentioned here would solve a long term problem. It would probably require two units, one for each coast. The issue of offensive mine-laying has been a real problem. (Figure 4). Those of you who have been involved in studies of mine warfare find that when push comes to shove, there is no one to lay the mines -- a lot of mines. Everyone says the P-3s or the A-6's are going to do this. But how are you going to get them there? The air assets always have 40 other things that are of higher priority, and it seems that if we had a very large submarine, which would be very easy to build, it would be capable of laying something on the order of 200-300 mines. This would allow the closing off of a whole area and in contested waters; this sort of capability would greatly reduce the mobility of a hostile force.

In addition, it wouldn't take much imagination to think of other things to use this submarine for!

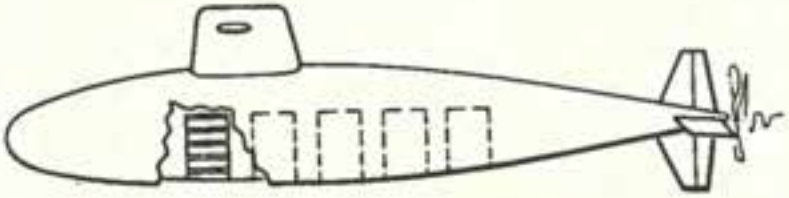

Figure 4

A final concept for the future, in support of the Maritime Strategy involves the reduction of the second most feared threat -- air attack. Clearly, forward attrition of Soviet Naval Air, to at least reduce the number of forward missile firing aircraft reaching the currently viewed weapon release line, is a major goal. Some of you have worried about the difficulty of destroying the long range naval air threat. Thus, why not build a submarine that is capable of carrying an AEGIS system with a limited number of missiles. It sounds bizarre. The idea would be to forward base a number of these submarines. Then with cueing, the submarine would surface. The hostile aircraft would be well within the envelope of detection and engagement of the submarine weapon system. In order to reduce the exposure of the submarine to missile attack, the need to have semi-active missile illumination of the aircraft target would have to be eliminated. This could be accomplished by developing a multi-mode guidance for the submarine launched missiles -- once it fired the missiles, the submarine would be free to submerge. As to how many such platforms might be needed, six on each coast appears reasonable. Just think of a six-submarine fan covering a sector of some hundreds of miles without an enemy force knowing they were there.

Our submarine force leaders should be encouraged to take on a serious study of new

concepts to articulate the course for the next 20-30 years. Obviously ideas like those presented here are not going to happen right away -- but they are more likely to happen if an active dialogue is generated amongst those interested in the future of the U.S. Submarine Force.

Gerald A. Cann

INTELLIGENCE INFORMATION FOR SUBMARINES

On looking back at my wartime experiences in Pacific Fleet submarines in world War II, I have concluded that inadequate emphasis was placed on providing commanding officers with intelligence information. Although the most important need of a commanding officer was where to find targets, there were other pieces of information that would also have proven useful. Among these were the locations of air bases, the ability of previous submarines to run on the surface in an assigned patrol area during daylight without undue Japanese interference, and, in view of the propensity of the enemy merchant ships to skirting the shores, how close had they approached the beach?, etc.

Looking back, I realize that neither COMSUBPAC nor any intelligence organization provided much information to submarines prior to departure on patrol. Perhaps they didn't have much to give. In any case, CO's were sent into assigned patrol areas and told to find their own targets as best they could. Other types of information on conditions in their assigned patrol areas were similarly neglected. For example, prior to departure on patrol, I was never shown a chart of my assigned area showing where earlier area occupants had made contacts or attacked ships. Nor was I ever shown a chart of actual or expected Jap shipping lanes, despite the fact that such lanes existed and were vital to the economy of the resource-starved Japanese Empire.

Another example of our lack of intelligence information pertains to the Japanese use of radar. I never saw a chart of enemy radar frequencies. Yet, radar signal intercept equipment was installed in our submarines as early as 1943. Our ECM equipment consisted of five or six separate and manually scanned tuning heads. But, due to the difficulty of searching the entire spectrum with the separate tuning heads, and the lack of information on enemy frequencies, it is doubtful that submarine ECM equipment was ever successfully used to detect approaching radar-equipped aircraft or ships. Twice bombed by Jap aircraft, once at night and once in broad daylight, I now realize that we failed to receive the tactical and technical information that could have allowed us to submerge before the bombs fell.

With regard to our own submarine operations, information was held so tightly that I, as a CO, was normally kept in the dark on my patrol assignment until the day of, or day prior to departure. Specific orders to my assigned patrol areas were usually handed me in a sealed envelope on the day of departure, with instructions not to open until at sea. On two occasions I was told (in great confidence) -- on the day prior to departure -- only the general area I was being sent to. Thus, I had little time to dig up information on my own. Further, I was never given an intelligence briefing prior to departing on patrol which described the conditions to be expected in the patrol area; i.e. the best hunting areas, types and volume of ASW activity, fishing fleet activity, suspected mine fields, etc.

Nor was there an intelligence debriefing on return from patrol. Much has been said about the value of ULTRA messages sent to submarines. There is a general impression that many ULTRAs were sent to submarines, producing many attacks on Japanese ships. Perhaps so, but in my own experience, this was not true. I remember receiving only two

ULTRAs during my last five runs. The first was in the fall of 1943. No contact resulted. A second ULTRA in the early spring of 1944 also failed to produce a contact. These results might have been affected by confusing instructions for determining expected contact positions near the equator.

THE BROAD SCOPE OF INTELLIGENCE INFORMATION

Few military people recognize the wide scope of Intelligence information. It embraces all the information necessary for military commanders to effectively plan and wage war against an enemy. The total information required by a commander can be subdivided into three major categories:

- Information on enemy forces;
- Information on own forces;
- Information on the geographic and geophysical environments.

Each category can be divided into subcategories, and those into individual elements such as a particular mark and model of a weapon, the payload carried, an electronic signal's characteristic, cloud cover over an ocean area, etc. Thousands upon thousands of elements are involved, and their numbers grow daily as new weapon systems and equipments are invented and introduced into the warfare arena. It may be that no single command requires information on all possible elements, but every level of command -- from a single submarine to the Joint Chiefs of Staff -- requires some of them.

THE INTELLIGENCE RATIO

Military commanders are generally familiar with the term force ratio. A concept similar to that of "Force Ratio" applies to the use of intelligence information, where:

$$\text{Intelligence ratio} = \frac{\text{Own Intelligence}}{\text{Enemy's Intelligence}} \text{ at the time of engagement}$$

The ability of a commander at any level, to effectively attack an enemy, can only be achieved by having readily available as much timely information on the enemy, own forces, and the environment in the area of operations as can be obtained. At the same time a commander must try to deny the enemy information on his own force. In short, his objective is to provide as high an Intelligence Ratio in a given battle area as practical. He must do whatever is necessary to increase the value of the numerator, and decrease the value of the denominator.

To illustrate this concept, consider some of the elements of the ratio available to a submarine force commander. First, the submarine force commander must increase the quality and amount of intelligence information supplied to his submarines. This can be done by:

- Extraction of pertinent intelligence data from the intelligence organizations of higher echelons;
- Extraction of pertinent data from contact and patrol reports;
- Debriefing personnel returning from patrol;
- Initiation of requests for tasking of all types of pertinent sensor systems;
- Timely analysis, integration and preparation of summarized data for use by himself and his submarines;
- Timely distribution of such data to all users by all means, including tactical data nets, and
- Briefings of submarine personnel on enemy capabilities, operational characteristics and tactics when they are in port.

Second, the submarine force commander must attempt to decrease the quality and amount of intelligence information that the enemy can obtain for distribution to his ASW forces and other units. He can do this by:

- o Varying operational deployment patterns and strategies;
- o Maintaining tight security of information on own force organization, assignments, movements, and tactics;
- o Minimizing requirements for communications from deployed units;
- o Employing deceptive strategies;
- o Initiating tasking requests to destroy enemy C^3I facilities and ASW capabilities, and to disrupt enemy communications.

The important point is that the submarine force commander must provide his operating units with the best intelligence information possible, and at the same time minimize the enemy's ability to gather and use information on our submarines which would be of value to his force.

The intelligence ratio concept applies equally to individual submarines. Prior to departing on patrol, the submarine commander must gather information on enemy capabilities as well as past and present conditions in the patrol area he'll operate in. This includes: locations of previous ship contacts and shipping routes; potential land targets; enemy ships and aircraft weaponry, nuclear payloads, ASW capabilities, tactics and bases; probable mine fields; enemy satellite reconnaissance systems; enemy low frequency sound detection nets, sophisticated C^3I systems, laser and infra-red detection systems, signal intercept systems, and technical advances in equipment characteristics and performance; etc. On station, the CO must use his personnel, his intelligence information along with his crew and equipment (particularly his sensor and tactical data systems) to obtain as much information as possible on the enemy's presence, actions and movements. He must, at the same time, deny the enemy knowledge of his own presence. If detected, he must use deceptive devices and tactics.

THE INCREASING NEED FOR INTELLIGENCE INFORMATION

The conditions experienced in World War II are gone forever. Today, force and unit commanders must consider the effects on submarine warfare of modern systems, equipments and new tactics. Any military commander who tries to plan and conduct future warfare on the basis of World War II technology and tactics will probably be defeated.

The information requirements of military commanders has exploded over the past forty years. A world War II submarine commander, for example, with his sub on the surface using a high periscope watch during daylight in clear weather would have a maximum range of about 20 n.m. to the mast tops of a ship over the horizon -- about the maximum effective SJ radar range on a ship and SD range on an aircraft. Thus, a CO's area of greatest concern was about 1,250 square miles. Then the submarine's effective gun range against land targets was less than two miles, so the CO had little need for information on land targets.

Today, with long range anti-ship and land attack missiles on board, the CO's area of interest has expanded to a radius of at least 1,000 n.m. This creates an area of interest of about 3,000,000 square miles, or an area some 2,400 times greater than in World War II. To be effective the CO needs information on all possible ship and land targets within range of his missiles. He also needs knowledge of the locations of enemy detection and weapon delivery systems as well as the orbital swaths of reconnaissance satellites. He must also know the characteristics of hostile detection and enemy missile homing signals -- and many other things too numerous to mention in this paper.

THE NATURE OF THE INTELLIGENCE COMMUNITY

Submarines on patrol have very limited means for gathering, analyzing, and integrating intelligence information. It is therefore essential that information obtained by the intelligence community flow down to this ultimate user. Critical information sometimes fails to get there due to a lack of appreciation of the user's needs. Hence, to solve this problem, the personnel generating and analyzing intelligence information on the user's problems should be educated by some first hand experience -- being onboard to view fighting without adequate information.

In other cases important information is denied users because of a "hold close" attitude. Part of this is a matter of politics, another arises from the need to protect information sources -- but this can be grossly overdone. For example, it was reported that Churchill decided not to defend Coventry against the expected German bomber raid of November 1940 because of fear that to do so would reveal that the British were able to decrypt messages encrypted by the German "Enigma" coding machine. However, a creditable cover story and other steps should have prevented the loss of this industrial center without compromising the British secret.

In summary, despite the fact that U.S. submarines did an outstanding job in bringing the Japanese Empire to its knees, they could have done an even better job sooner if the need to provide better intelligence information to submarine CO's had been better understood.

We now live in a world of continually increasing advanced air, land, sea, undersea and space weapons, and C^3I systems of very sophisticated performance capabilities. The present day submariner's need for intelligence information at force and operating unit levels has become many,

many times greater than ever before. This information must get to the user. In this regard, it must be emphasized that individual submarines are the submarine force commander's weapon-delivery units, and hence the information users.

William P. Gruner

CANADIAN NAVY STEERS NEW COURSE

During the tabling of the first White Paper on Canadian defence policy in over 15 years, the current Canadian Minister of National Defence, the Honourable Perrin Beatty, in his speech to the House of Commons on June 5 of this year said, "The real question is whether Canada can afford to have a modern navy or, perhaps more accurately, whether a three ocean nation as dependent on trade as Canada is, can afford not to have a navy? The Government's response is clear." What surprised many however, was the nature of this response -- the acquisition of nuclear-powered hunter-killer submarines and a new era for Canada's undersea service.

The nearly two decades of fiscal restraint and reduced resources resulting from the 1971 White Paper could not but have had an eventually detrimental impact on the Canadian Armed Forces. Nowhere has this been more evident, and more disconcerting, than in the deplorable state of the Canadian Navy. Canada is a sea-faring nation, with a proud maritime tradition. Nevertheless, current Canadian naval assets are built around a mere 4 destroyer squadrons totalling twenty elderly destroyers (the newest of which are now over 15 years old), and one submarine squadron of three submarines. Canada's tiny submarine force is made up entirely of 1960's vintage OBERON-class diesel-electric boats acquired from the United Kingdom.

The previous policy statement of 1971 reflected the political situation of the early 1970's, understandably an optimistic document. Then the era of detente and a new dawn in East-West relations seemed to be just over the horizon. This optimism, however, did not survive the end of the decade. Soviet adventurism in Africa, Asia, Central America and other areas of the world cast a pall over East-West relations and provided a graphic indication that our interpretation of "detente" differed radically from that of the Soviet Union. Even more disturbing, however, to Western military experts was the continuing build-up of Soviet nuclear and conventional forces throughout this period and the new ability of the USSR to project its military strength globally.

The 1987 White Paper acknowledges the changed atmosphere and reaffirms the present Canadian Government's intention to meet the perceived threat and correct the years of neglect suffered by the Canadian forces, thus enhancing Canadian security and the Western Alliance's deterrence posture. The authors of the White Paper might well have had U.S. Navy Rear Admiral F. Pittenger's thoughts in mind, when he noted recently that "Deterrence is the primary mission of the navy." As the Canadian Navy had drawn the short straw in recent years, it is understandable therefore that the major focus of the present policy statement should be on the reconstruction of the maritime element.

The announcement of Canada's intention to acquire a fleet of SSNs has caught some by surprise. The rationale for the decision though can be found in the Government's new emphasis on its three ocean responsibilities. In particular, nuclear submarines are expected to offer Canada an under ice capability and an opportunity to patrol the waters of its Arctic regions. Canadian defence planners have viewed with some concern the expansion of the USSR's submarine forces in recent

years, especially its growing capacity to launch long-range land-attack cruise missiles against Canadian and American targets in North America from off-shore as far north as the Labrador or Bering Seas, thus augmenting its longstanding SLBM capability. Further, Canadian Arctic waters could well provide the Soviets with an alternate route to the Atlantic and Pacific to take up cruise missile or ballistic missile firing positions or prey on Allied shipping. To again quote Rear Admiral Pittenger: "...the Navy's ability to handle the hostile submarine problem bears directly on our ability to deter Soviet aggression and to defend ourselves. After all, if we can't do ASW, we can't do much of anything at sea." This statement echoes Canadian sentiments.

Sufficient naval forces, properly deployed, can keep an opponent at arm's length, thus providing strategic depth. The logic of the U.S. Navy's own forward maritime strategy cannot be denied in this regard. Alternately, Canadian naval forces must also be able to respond to challenges within Canadian territorial waters. Finally, Canada must also contribute to the collective maritime strength of the North Atlantic Alliance, and notably to honour its NATO commitment to maintaining the sea-lines of communication to Europe. The Canadian Navy is currently hard-pressed to meet its obligations in the Pacific and Atlantic, and, despite growing indications that the Arctic basin is becoming an important operating area for Soviet submarine forces, has no capability to carry out any of these roles in the North.

The focal point of the navy's revitalization efforts will therefore be the SSN program. Submarines are essential to meeting Canada's current and future maritime control and surveillance commitments. The Canadian Submarine Acquisition Program was initiated in 1984 to identify a suitable conventional replacement for

the OBERON fleet. This program was, however, unable to meet the expanded priorities identified by the White Paper. Nuclear-powered submarines are not only uniquely capable anti-submarine platforms, they are also the only elements able to meet Canada's three-ocean and under-ice requirements. A fleet of 10-12 boats will permit submarines to be on station on a continuous basis in Canadian areas of responsibility in the northeast Pacific, Arctic and north Atlantic Oceans. The ultimate aim is the enhancement of Canadian, North American and Western security through a reduction in the options available to Soviet sub-surface assets in time of conflict.

Concerns have been expressed as to the perceived lack of Canadian experience with submarine technology.

Canada has had, on the contrary, a long experience with submarining dating back as far as 1908. Canada's first two submarines were purchased, oddly enough, by the premier of the province of British Columbia from Chile in 1914. These were replaced in 1919 by ex-Royal Navy boats originally built in the Quincy Shipyards in Massachusetts. Canadian submarine assets during the Second World War were augmented by the capture of two German U-boats, the U-190 and U-988. Post-war purchases included two TENCH-class submarines acquired from the U.S. Navy in 1961, followed in the early 1970's by the British "O"-class boats currently comprising Canada's submarine squadron. Thus while having no indigenous submarine construction capability, the Canadian Navy has ably demonstrated for decades its ability to adapt and operate submarine technology from a variety of foreign sources.

The transition to nuclear-powered submarines will indeed usher in a new era for the navy. Nevertheless, nuclear power is not a new field for Canada by any means. Today, the Canadian nuclear

industry is a robust one. Using the unique CANDO heavy water technology, provincial utilities in Canada now operate 22 domestically-produced commercial reactors. A further 11 research reactors are also functioning throughout the country. Approximately one-third of the electrical needs of Canada's most populous province, Ontario, is currently met by nuclear power. The acquisition of nuclear submarine technology will be a new challenge, but one well within existing Canadian nuclear expertise.

The acquisition of SSNs will be a costly undertaking. The Defence White Paper did not attempt to paper over this fact. The Department of National Defence has estimated the cost of 10 SSNs at 8 billion (U.S. $6 billion), with $5 billion earmarked for the boats themselves and a further $3 billion for training, infrastructure and weapons. This $8 billion will be part of the overall $200 billion 15-year program to re-equip the forces outlined in the White Paper. The Government is committed to a base 2 per cent real growth increase in defence spending during this period. Should this projection prove to be insufficient to cover all the programs outlined in the White Paper, the Government will also conduct a rolling 5-year re-examination of the defence budget each year.

Nevertheless, it is anticipated that the new SSN program will be possible without any new massive adjustment to that portion of the budget earmarked for the navy. Costs will be borne primarily by the cancellation of the third batch of frigates projected for the late 1990's and the conventional submarines program. Both projects had been identified prior to the preparation of the 1987 White Paper and neither are suited to its new areas of emphasis. In addition, the SSN acquisition program will be stretched out over the period 1996-2010 in order to further reduce pressure on the defence budget. The ultimate

composition of the Canadian Navy early into the next century will therefore be fewer vessels, but better balance and enhanced capabilities. The SSNs will provide greater speed, agility, and stealth than their surface counterparts, in addition to providing that crucial three-ocean capability.

Of the five nations currently operating nuclear-powered submarines, obviously only three, the US, UK, and France would be appropriate sources of the technology required. Primary interest is currently focussed on the British TRAFALGAR-class boat built by Vickers Shipbuilding Engineering Ltd. of Barrow-in-Furness, and the French RUBIS-class produced by the French Government shipyards in Cherbourg. Covetous Canadian eyes have closely examined the LOS ANGELES-class of hunter-killers, but the associated billion dollar price tag will likely eliminate it from the competition. The TRAFALGAR appears to be the current favourite, as some concern has been expressed about the relatively noisy signature and small size of the RUBIS. Competitive bids for the programme have been called for and the Defence Department will indicate its preferred option in December, 1987. The winner will then be asked to submit a detailed cost and design proposal for final approval. Current projections call for up to 65 per cent of the construction to take place in Canada.

Canadian SSNs are not intended to compete with nor replace the nuclear-powered assets of other Western allies, nor their current roles. There should be no doubt about Canada's commitment to the acquisition of nuclear submarines. Similarly, there should be no inhibitions on the part of its nuclear-capable allies in sharing their own knowledge and expertise. The sooner Canada's SSN fleet becomes a reality, the sooner it can contribute to the defence of common Western interests.

Relative to this year's Defence White Paper, Defence Minister Beatty's June 5 remarks to the House of Commons have set the tone and issued the challenge, "We must do our fair share in carrying the burden of collective defence if our views are to be respected and our independence preserved.... we now have a coherent comprehensive defence policy framework, a road map to guide us into the twenty-first century."

That road map promises to take the Canadian Navy beneath the waves.

R. E. Stansfield

BOTTOM MINES FOR SUBMARINES

Recent events illustrate the potential that covert minefields possess. In 1984 a clandestine minefield disrupted merchant shipping in the Red Sea. Early this year a minefield was discovered in the Persian Gulf. But the mines used in these two instances were different in type and fuzing.

A mine recovered by British divers in the Red Sea was a modern Russian 955, "state-of-the-art" influence-fired bottom mine. This mine could have been launched by surface vessels or submarines. But the suspicious damage to the stern ramp of a Libyan merchant ship has led many to believe that the minefield was sown by surface means. It was a type which rests on the bottom and allows a passing vessel's magnetic and accoustic signatures to detonate it.

The mines used in the Persian Gulf crisis are of an old Russian M-08 design. These are moored contact mines which must be struck by ships to initiate a detonation. Like the Red Sea incident, these mines were sown by surface vessels and eventually exposed the perpetrators and thus reduced the effectiveness of the minefield.

To effectively deploy a clandestine minefield the delivery vehicle must remain concealed. The ideal vehicle for this is the submarine. Unfortunately for U.S. attack submarine use, there are only three mine types currently available. These include the MK 60 encapsulated torpedo (CAPTOR) ASW mine, the MK 57 moored influence ASW mine, and the newly developed MK 67 submarine launched mobile mine.

The CAPTOR mine is a moored encapsulated MK 46 torpedo. This deepwater mine is principly used as an anti-submarine barrier weapon. Once a submarine is detected the MK 46 torpedo breaks free of its capsule to home on the submarine. At 1985 prices each CAPTOR costs about $350,000. Its high cost and limited mission reduces the employment of this mine to several unique global regions.

The MK 57 moored mine is the only stockpiled submarine-launched mine for use against enemy submarines as well as surface ships. Once detected, such a moored mine is relatively simple to sweep and neutralize. Additionally, using this mine in shallow water makes it much more vulnerable to sweeping efforts. As such, its value as a weapon is severely reduced. Although it encumbers the enemy's mine hunting force, channels can be quickly cleared and shipping movements can return to normal.

The mobile mine is essentially a MK 37 torpedo with a mine for a warhead. The submarine launching platform is able to stand-off from its target and release this mine. The MK 67-mine would then follow a predetermined guidance program to its designated resting spot. Once at that spot the torpedo would stop and the unit would rest on the bottom and function as a mine. The planned procurement for this mobile mine in 1987 was over 250 units, but seemingly the program has been cancelled. However, a low-cost bottom mine is

still needed for U.S. submarines to be used against enemy submarines as well as merchant or naval ships.

The last "bottom mine" designed for submarine use was the MK 49, but the Navy withdrew the MK 49 from service in 1970. The MK 49 was deployed like a torpedo using an influence triggering mechanism. Later production models incorporated the Destructor target detecting device as the primary firing mechanism.

While analyzing the 1987 fiscal year budget for the Navy, Congressman Thomas F. Hartnett (R-SC), could not believe that sea mines were not on the list of Navy weapons requested. However, due to other procurement priorities, the Navy's plans for CAPTOR and the MK 67-mobile-mine had been modified adversely. Hartnett sincerely believed that the United States could offset the naval disparity with the Soviet Union by using a force multiplier -- the sea mine. But, over a year has passed and the production of sea mines for the Navy is either minimal or nonexistent. Yet, there are several alternatives to boosting the submarine force mine inventory. One possibility is to modify some existing mines for use by submarines.

Current Navy doctrine calls for using aircraft as the primary platform to lay bottom mines. It should be noted however, that the use of aircraft compromises the covertness of its minefield. Only submarine laid mines have the potential of remaining undetected. Thus it is reasonable to modify mines produced for aircraft delivery. The current Destructor and Quickstrike mines with modification could be used by submarines.

These air-delivered mines utilize the MK 80 bomb as the main charge. A target detecting device is installed in the rear of the bomb and an arming mechanism is located in its nose. When

released from the aircraft the rotating vanes in the nose fuze arm the mine. After entering the water the mine sinks to the bottom and awaits its target.

Modifying the Destructor or Quickstrike mines for submarine use is possible with relatively minor alterations. To make the mine compatible with a torpedo tube, a sabot sleeve can be fitted over the mine case. Sabots commonly used in ground weapon systems are essentially a plastic sleeve fitted to a subcaliber projectile. The sleeve allows the smaller projectile to be fired from a larger caliber gun. This technology can be applied to the Destructor and Quickstrike mines enabling them to conform to the twenty-one inch diameter torpedo tubes. The mines, already aerodynamically shaped, should have little problem being launched from torpedo tubes. As for the arming device in the nose, a completely new arming device will have to be fabricated to allow for both safe ejection from the submarine and sufficient time for the submarine to clear the area prior to the mine being armed. A hydrostatic arming device might be used in conjunction with a water soluble washer to prevent the extender from arming until the washer is dissolved.

The use of modified Destructor and Quickstrike mines would enhance the submarine mine warfare mission. They will provide our submarine fleet with a variety of influence bottom mines up to 2000 pounds. The advantage of such mines is that they are highly target selective, difficult for enemy mine countermeasure forces to sweep, and difficult to locate for neutralization.

The need for a bottom mine which can be used by submarines can not be over emphasized. The Red Sea mining incident of 1984 demonstrates that the Soviet Union continues to maintain state-of-the-art bottom mines which are capable of submarine

deployment. Indeed, the Soviet Union considers the submarine as the ideal mine laying platform.

Targets for these weapons will be mainly surface vessels and not submarines. The Soviet Union ranks second in the world's total merchant shipping with over 2,500 vessels. Of these, the heavy tonnage ships are tankers, dry and combination cargo ships, and timber carriers. Since sea lines of communication are critical to the Soviets, as they are to the West, the bottom mine is a good means for shipping interdiction. Should Soviet naval vessels become victim to the bottom mines so much the better. The blockade effect is also initiated once the first mine detonates and the enemy's mine sweeping forces are overwhelmed in their efforts to neutralize the minefield. Further discussion of the submarine mine laying capability needs to be generated.

Jeffrey K. Bray

SUBMARINE WARFARE
PROSPECTS FOR THE TWENTY FIRST CENTURY

In order to consider the possible evolution of submarine and antisubmarine warfare into the twenty first century, the focus of any analysis should be on some narrow regime of warfare. In this case the regime would be warfare between attack submarines and between SSNs and SSBNs.

Both attack submarines and strategic submarines have continuously grown in size and complexity. But there must be a limit to the growth of the size of submarines and it is a valid question as to whether or not there is an optimum size for attack submarines which designers should aim for in the near future. This size should be at least partly determined by scientific, engineering, and technological advances now available or expected soon.

An alternate way of viewing the question of size would be to select a size that would be in accord with a selected set of tactics -- then optimizing the attack submarine's capabilities in accord with that size and that set of tactics.

The technology to be examined with regard to the production of the next generation of attack submarine and its associated tactics should encompass the efforts of the Strategic Defense Initiative (SDI). From the SDI are coming new and modifications of old concepts, techniques, and hardware in the realms of battle management, computers, artificial intelligence, materials, and propulsion to emphasize only a few aspects of this project.

By using SDI advances, it becomes plausible to arrive at a scenario for future underwater combat wherein attack submarines -- substantially smaller than submarines of the present generation -- are used in coordinated groups.

As the size of an attack submarine is decreased, the feasibility of maneuver warfare for the underwater domain is increased.

Although maneuver warfare has always applied in some sense to submarines, the execution of this type of warfare has been limited by a number of factors. These factors include hull strength, size, and propulsive power.

The three-dimensional reality of the oceanic environment however, can be exploited for the purposes of maneuver warfare by a generation of attack submarines that is radically different from that which now exists.

By decreasing hull size the potential is raised for quieter running with less volume being present to generate sound, and less surface being available to radiate sound and vibration into the

enveloping ocean. The realization of this potential depends, as in all of the aspects of the design of this new attack submarine, upon the application of the appropriate technology. Although research submarines have been the only submarines to reach great depths, the smaller size of a new generation attack submarine, combined with advanced high-strength structural materials should allow a far greater depth capability to be achieved in SSNs. Some of the materials to be considered include metal matrix composites, plastic matrix composites, and rapid solidification processed metals, with alloys of iron and of aluminum as possibilities. Such new materials combined with new nuclear power technology would still yield a submarine volume sufficient for personnel and equipment to successfully fulfill required missions.

The topography of the oceanic environment can thus be more readily utilized for concealment and for tactical advantage by smaller submarines. The hills, mountains, valleys, and canyons of the sea bed and the ice structures lying below the surface of the sea can enhance the security of a small attack submarine while providing a magnified threat to enemy submersibles. A group of convolutions on the sea bed might be too large to be of benefit to a large submarine, while a small submarine could immerse itself among those folds. By being able to penetrate the convolutions, the small submarine could gain more sound and vibration propagation damping and muffling and perhaps better execute an attack upon the enemy with an increment of the surprise element.

The power plant and propulsion system driving a small attack submarine would necessarily have to differ substantially from what is currently available. This increase could be attained through manipulation of the nuclear reactor core geometry and the utilization of more efficient neutron reflectors. Improved shielding would

provide a sufficient safety margin. An increase in the heat transfer efficiency could be obtained through modification of the working fluid circulation geometry to magnify the transfer area. The experience of the United States with the development of nuclear fission reactor rocket engines would be pertinent to the procurement of the small attack submarine reactor.

Non-propeller propulsion systems in the form of jet propulsion might be considered for utilization on this submarine. With proper design, the potential exists for a faster submersible generating less noise than would be expected from present designs. The electric motor-generator set driving a propeller mounted on a shaft would be eliminated along with this source of vibration and sound. Pumps and compressors could be driven by direct energy conversion devices that, in the case of thermoelectricity, would transform the reactor heat into electricity. Although the flow of the sea water which acts as the reaction mass through the submarine might be a source of noise, manipulation of the boundary-layers involved and attention to the maintenance of laminar flow could minimize noise generation making it less than the noise produced by an equivalent propeller drive.

If a propeller drive, however, should be deemed to be the appropriate system, direct energy conversion devices could be scaled up in power level to at least eliminate the generator part of the generator-motor set. Also, a means of generating electricity through the exploitation of superconductivity and using it to drive a coupled motor via the utilization of direct current homopolar machines based upon the use of superconducting magnet coils, now has an enhanced attractiveness.

Magnetic propulsion is another option that might be investigated as a non-propeller mode in which the field is generated by superconducting

magnets. This option could be impractical if the required magnetic fields could not be confined to the immediate vicinity of the submarine. This situation would yield a non-acceptable magnetic signature which could be detected by enemy vessels.

Reduction of the size of the submarine implies a similar reduction in the size of the crew. The crew reduction could occur through the utilization of artificial intelligence and automation -- and other expert systems to maximize the efficiency with which sophisticated weaponry and other offensive and defensive systems are employed and deployed. Such equipment would allow the performance of intricate maneuvers in the benthic layer along the bottom of the ocean, with its complex topography. This could not be performed by unaided crew personnel safely or not at all in some cases.

Also, the implementation of more complete four dimensional space-time tactics become practical. It makes practical the replacement of solitary actions by an individual attack submarine with group actions of three or more submarines linked together by their command, control, and communications systems -- in a three-dimensional volume bounded by the sea surface and the ocean floor.

Group combat operations require close-knit communications but the oceanic environment presents a chronic problem for communication between submarines. A feasible solution is to use lasers tuned to regions of the electromagnetic spectrum at which ocean water is reasonably non-attenuating. The SDI program has been prominent in laser research and the proper laser may already exist. Although the laser itself is restricted to line-of-sight usage, it might be possible to develop a laser communications system that could utilize radiation scattered from the ocean surface

and the sea floor. Such a scattering approach is not totally secure, but a reasonable level of security could be maintained through the use of coding and the restriction of scattering mode transmission to situations wherein eavesdropping is not a severe detriment relative to the benefits to be accrued by such transmissions.

Group operations have advantages over lone wolf operations in terms of concentrated firepower and mutual defense. With close enough spacing, the respective spheres of influence overlap so as to enhance the intensity of firepower being focussed on the enemy in an offensive situation context with similar enhancement for the mutual defense situation.

Coordinated group action should take less time for the applied firepower to be effective. Time is always a critical factor in submarine operations and this is especially important in the event of the action of a group of American attack submarines against an enemy strategic nuclear submarine within the context of the initiation of a global nuclear conflict.

A group of three small American attack submarines could more efficiently neutralize an enemy SSBN than would be the case of a one on one attack by a single attack submarine. Neutralization could entail diversion of the enemy SSBN from its route to its launch point, or the prevention of a launch of its missiles.

Group tactics can likewise be used against enemy attack submarines whether or not the enemy itself is grouped or is operating individually. For attack against SSNs, moreover, the time required for neutralization of the enemy is not so critical a factor.

By utilizing the small size, speed, and maneuverability of small nuclear submarines, a

submarine battle group could use tactics akin to those usually associated with aerial warfare -- resulting in concentrated weapon power, mutual protection, surprise, deception and confusion for the enemy.

However, there are limits as to how undetectable a submarine can be rendered -- whether the detectable characteristics be acoustic or non-acoustic, still the contemplated size reduction of a new SSN should enhance its non-detectability means of obfuscation of its strategic and tactical modes of operation. This should additionally enhance the submarine's survivability.

Decoy countermeasures and platforms could be deployed under attack conditions. A decoy platform unlike many countermeasures would have no propulsive system of its own and depend solely upon the ocean currents for its motion -- broadcasting taped submarine noises or wide band noise to confound the enemy's sensors. As with the design of a small attack submarine system, advanced micro-miniaturization is essential throughout the design of the electronic and non-electronic components of countermeasures.

The countermeasures would fulfill a range of objectives. A sufficiently high noise level in terms of amplitude and variety could overload enemy identification and tracking capabilities. It should be possible to make a battle group of three subs seem to be a single submersible. An entire panoply of electronic warfare measures should be assisted in its development by the adoption of some of the on-going research and development of the SDI program.

The SDI program could also prove useful in providing new offensive and defensive weapons for the next-generation attack submarine. Kinetic-kill torpedoes with a solid non-explosive warhead of high strength and great hardness and loaded

with depleted uranium for inertial mass could be rocket boosted before impact to provide maximum velocity at the surface of the enemy submersible. Other non-explosive devices could be constructed that would be oriented toward crippling the enemy's maneuvering and steering mechanisms.

New American attack submarines and submarine tactics of the twenty first century should be radically different from what is now the case. The decision must be made in the not too distant future as to the character of a next generation submarine to counter the ever-growing threat posed by the Soviet's greatly improved submarine force.

Dr. Bruce Friedman
Chesnid Associates

NAVAL UNDERSEA MUSEUM UNDER CONSTRUCTION

The Naval Undersea Museum Foundation resumed construction of the Naval Undersea Museum at Keyport, Washington on 15 July 1987. Phase I construction is now underway. Additional exhibit areas and a 500 seat auditorium will be added in subsequent phases as additional funds become available.

A nationwide fund raising campaign is in progress to raise the estimated $6.6 million needed for all three phases of museum construction and major exhibitions. The Navy has donated a site overlooking the lagoon near the entrance to the Naval Undersea Weapons Engineering Station (NUWES) at Keyport, Washington, and will operate the facility when construction is complete. Currently, close to $3 million has been raised from private and corporate donations. A vigorous Museum membership campaign was kicked off in January in Washington State at a dinner attended by Washington Governor Booth Gardner, with member-

ship now approaching 12,000 in the local area alone.

The Naval Undersea Museum will serve as a counterpart of the Navy Museum at the Navy Yard in Washington, D.C., the Naval Aviation Museum in Pensacola, Florida, and the Submarine Museum at Groton, Connecticut. The Naval Undersea Museum is located in the Pacific Northwest at Keyport, because of Puget Sound's strategic importance in naval affairs and Keyport's historic role in undersea systems development. Plans for the Museum's exhibitions are being made with the advice and guidance of naval historians and individuals long associated with the Smithsonian Institution.

The Foundation is looking for assistance from Naval Submarine League members, retired military personnel, industry, and community leaders. A $15 donation will secure a lifetime family membership in the Museum Foundation. Individual memberships are $10. Corporate and Foundation donations are also being solicited.

The Museum is a particularly exciting development for Naval Submarine League members and those interested in the historical development of undersea technology! While the central thrust of the Museum is the underwater weaponry of ASW, the historical presentation of the development of the ASW roles would be incomplete without a significant treatment of the magnificent contributions of our Submarine Forces over the years. Non-combatant undersea achievements will also have a place in the Naval Undersea Museum.

Consistent with the museum's broadened scope of interest, TRIESTE II will be transported to the museum as soon as a ship can be scheduled for it, from the east coast. TRIESTE II was rebuilt from TRIESTE I, which -- manned by Picard and Walsh -- made the world's deepest dive to the bottom of the

Marianas' Trench, 35,800 feet down. The dive was made in January of 1960. TRIESTE was also used in the discovery of the wreck of the TITANIC, the examination of THRESHER and SCORPION remains on the bottom, and recovery of the Palomares nuclear bomb. Similarly, a WW II 5"-25 Mk40 wet-mount submarine gun will be on display. The primary reason for its success -- as the best submarine gun of WW II -- was that it was free flooding, using a dropped breach block and having no plug in the muzzle which had to be opened for draining after the submarine surfaced. This made the gun ready for immediate use as the water flowed out of the barrel on breaking free of the ocean.

If you would like to become involved in the work of the Naval Undersea Museum Foundation, contact the Foundation office at Building 57, Washington Navy Yard, Washington, D.C., 20374. Documents or artifacts appropriate for display or presentation in the archives of the Museum may be sent directly to the Museum Director at the Naval Undersea Warfare Engineering Station, Keyport, Washington, 98345-0580.

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SUBMARINE MANEUVERING INSTABILITY

Very little unclassified information has been published concerning the roll-yaw hydrodynamic instability of modern high-speed submarines. In particular, it appears that there is little understanding of the fluid-flow mechanism involved in the fairwater (sail)-hull interaction in a coordinated underwater turn. This article analyzes the results of smoke-flow studies conducted on a 1/75 scale model of the SSN 585 SKIPJACK submarine simulating a rolling-yawing turn.

It is obvious from studying photographs of the several new Russian attack submarines that they are attempting to solve the well-known "snap-roll" maneuvering problem. Modern submarines cannot maneuver underwater with great abandon like an F-16 fighter plane. One reason is that their hull crush-depth is only 4-6 hull lengths away and another reason is that if, in a melee situation, a modern high-speed sub pilot tries to turn too sharply at too high a speed, he might find himself in a snap-roll, hanging from his seat belt and with a loss of several hundred feet in depth at a markedly slowed speed.

With our limited number of subs, we should be addressing this problem so that our attack subs can out-maneuver the other side in shallow waters as well as deep water.

Although the SKIPJACK was the first nuclear attack boat to utilize the new body of revolution hull design as pioneered by the ALBACORE (AGSS-569), the same basic hull form has been used on both the 637 class and the 688 class designs, deviating only in length, i.e. fineness ratio, to accommodate more equipment and a larger reactor in the case of the 688 boats. A considerable body of aeronautical data exists from the study of bodies of revolution, as applied to airships and missiles, which has been useful to apply to the

modern submarine shape.

A simplified analogy of the body of revolution hull form might be useful at this point: We have all seen the wing-tip vortices -- usually in wet weather -- generated by aircraft, particularly when taking off or landing. If one were to simply eliminate all the wing between each tip, and then join the two symmetrical wing tips together, as a body of revolution, it can be seen that this also would generate two vortices rolling up inwardly toward each other at any time that the body of revolution was inclined to the free-stream flow.

These two vortices are relatively harmless on an airship, blimp, or missile, but their interaction with the submarine sail appears to be the root cause for the inability of the modern submarine to maneuver underwater with the same sort of stability as airplanes in the atmosphere.

To verify the simulation of wind-tunnel submarine data vs. full-scale data (in water), a drag coefficient vs. REYNOLDS NUMBER (Cf vs. Nr) plot was obtained for the wind tunnel model and compared with the data obtained from the David Taylor Model Basin (DTMB) model tests. Since data from full-scale sea trials has been in good agreement with the DTMB model data, this would appear to be a good comparison.

Before discussing the wind tunnel results on the SKIPJACK model a few thoughts about laminar flow, turbulent flow, separated flow and Reynolds number for submarines might clarify what was observed.

The fully immersed streamline bodies that are typical of modern submarines produce very little wake, and their drag, or resistance to forward motion, is composed almost entirely of skin-friction drag. And this drag, for any given hull

shape, will be dependent on REYNOLDS NUMBER, or the ratio of inertia forces to viscous forces, for any body sliding through the sea. REYNOLDS NUMBER is basically a scaling factor which is important so that one can test models and correlate their data with the full-scale desired results. REYNOLDS NUMBER is also important because it helps to define the demarcation between the very low drag created by LAMINAR FLOW of the water next to a sub hull and the 300-400% higher drag of the TURBULENT FLOW next to the hull.

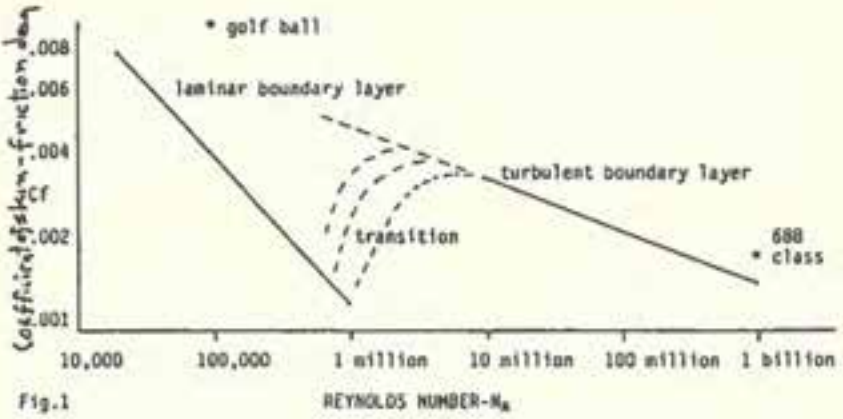

Fig.1

The layer of water next to a modern submarine hull, called the boundary layer, normally will be less than 1/2 inch in thickness from the bow past amidships.

In the study of the fluid dynamics about a moving submarine hull, the predominately TURBULENT FLOW boundary layer over the hull is generally easier to control than a laminar boundary layer. The story of the common golf ball can be useful to illustrate how this comes about:

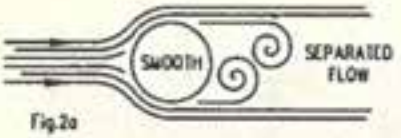

Fig.2a

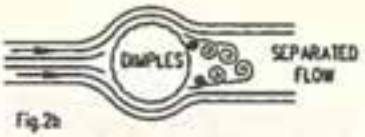

Fig.2b

If one were to take a perfectly smooth golf ball and wallop it down the fairway with one of your best "250 yard" drives, you would be sorely disappointed to find the smooth-surfaced ball travelling only about half that distance! It is true. Note in fig.2a how the laminar airflow passes over the ball in smooth layers but when these layers reach the backside of the ball they can no longer adhere to the ball's surface so they SEPARATE and form a large drag-producing separated wake. Now if one were to rough up the surface of the ball with small 1/8 inch dimples, it is easy to see, fig. 2b., that this will create a high energy TURBULENT layer of air next to the ball. This turbulent boundary layer has a little more energy in it so that when it sees the back side of the ball, it continues around the dimpled surface just a little further before it finally separates away. This leaves a smaller drag-producing wake than the smooth ball.

SEPARATED FLOW must be avoided at all costs on a submarine if only because of the resulting severe wake noise. Thus, a proper design should utilize a basic body of revolution and clever control plane design and placement to create a separation-free underwater vehicle that is quieter and faster.

FLOW STUDIES:

The test model was photographed in four different positions which are of interest in examining a coordinated undersea turning maneuver in the lateral plane.

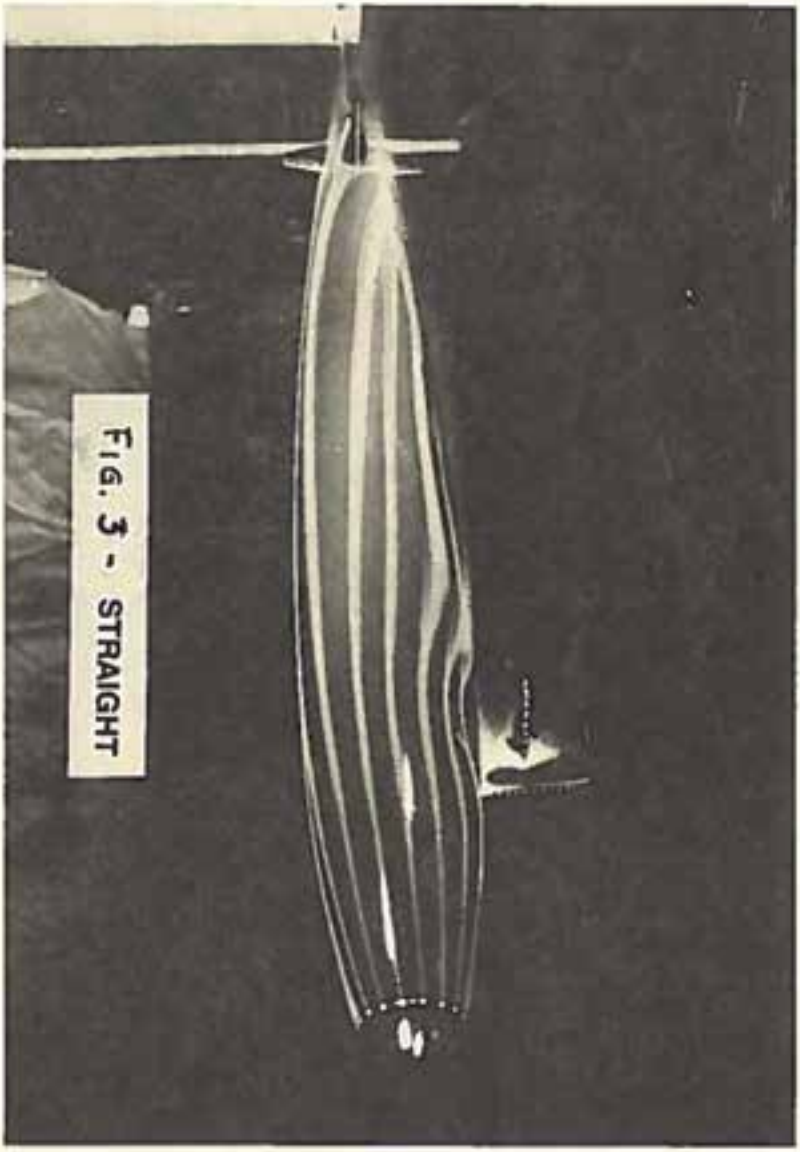

FIG. 3 - STRAIGHT

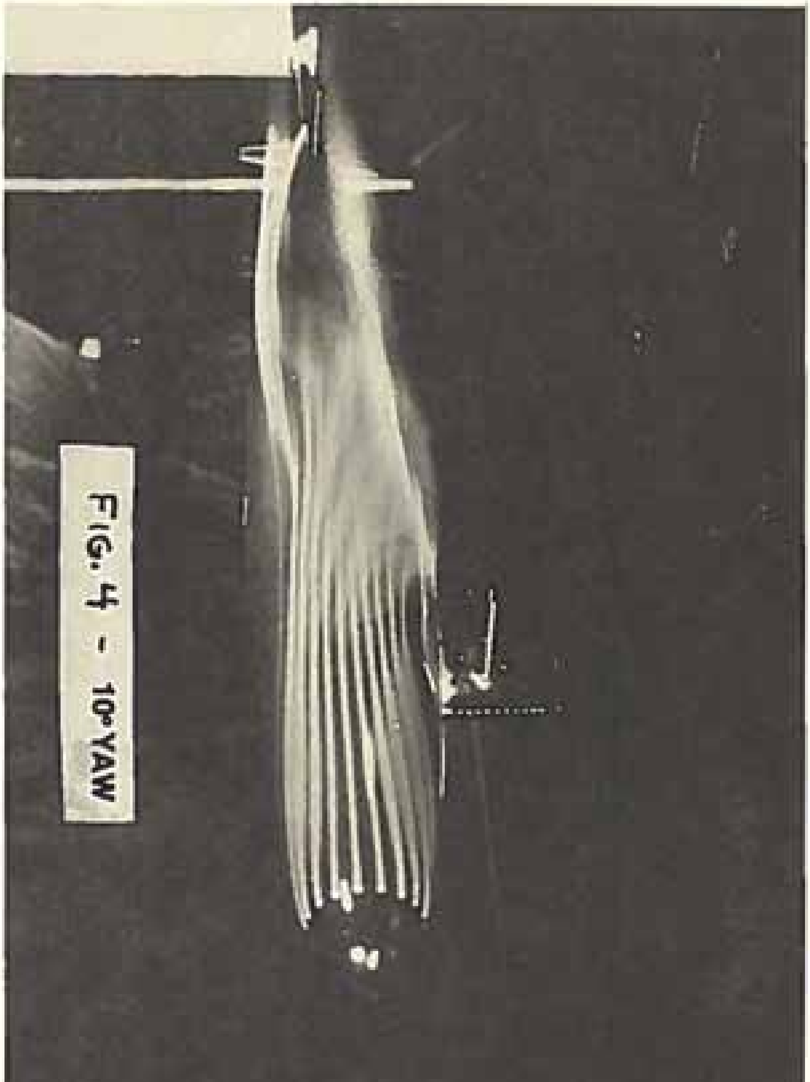

FIG. 4 - 10° YAW

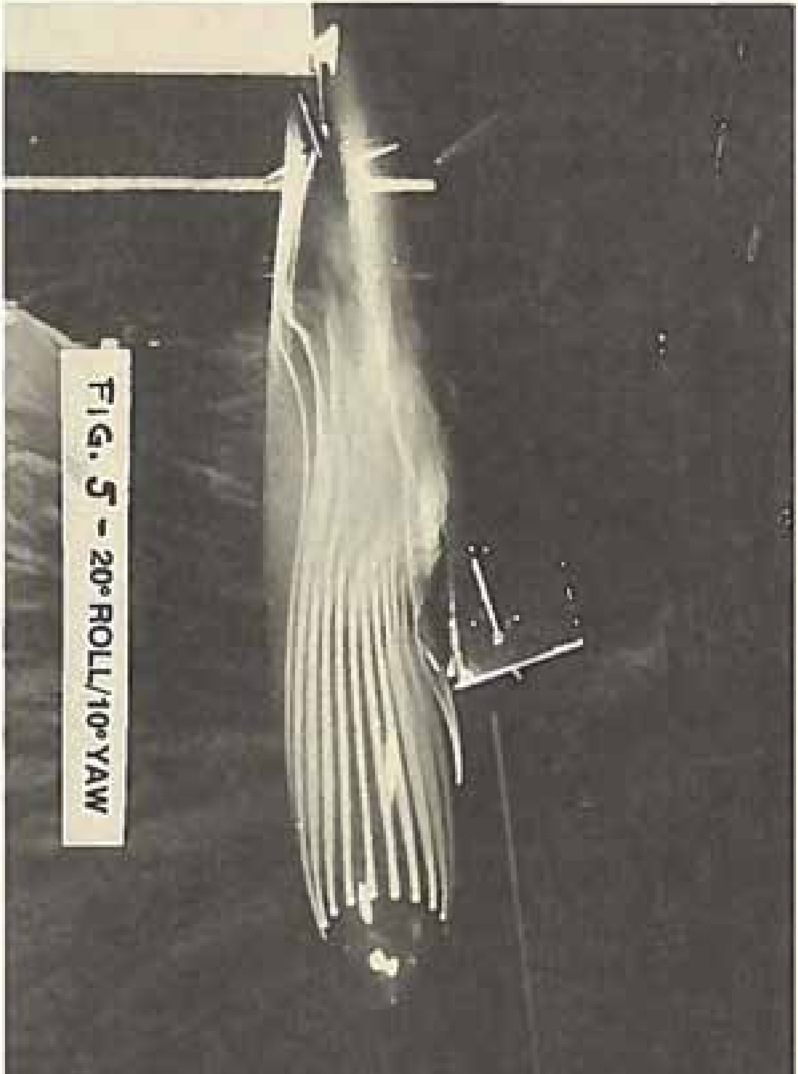

FIG. 5 - 20° ROLL/10° YAW

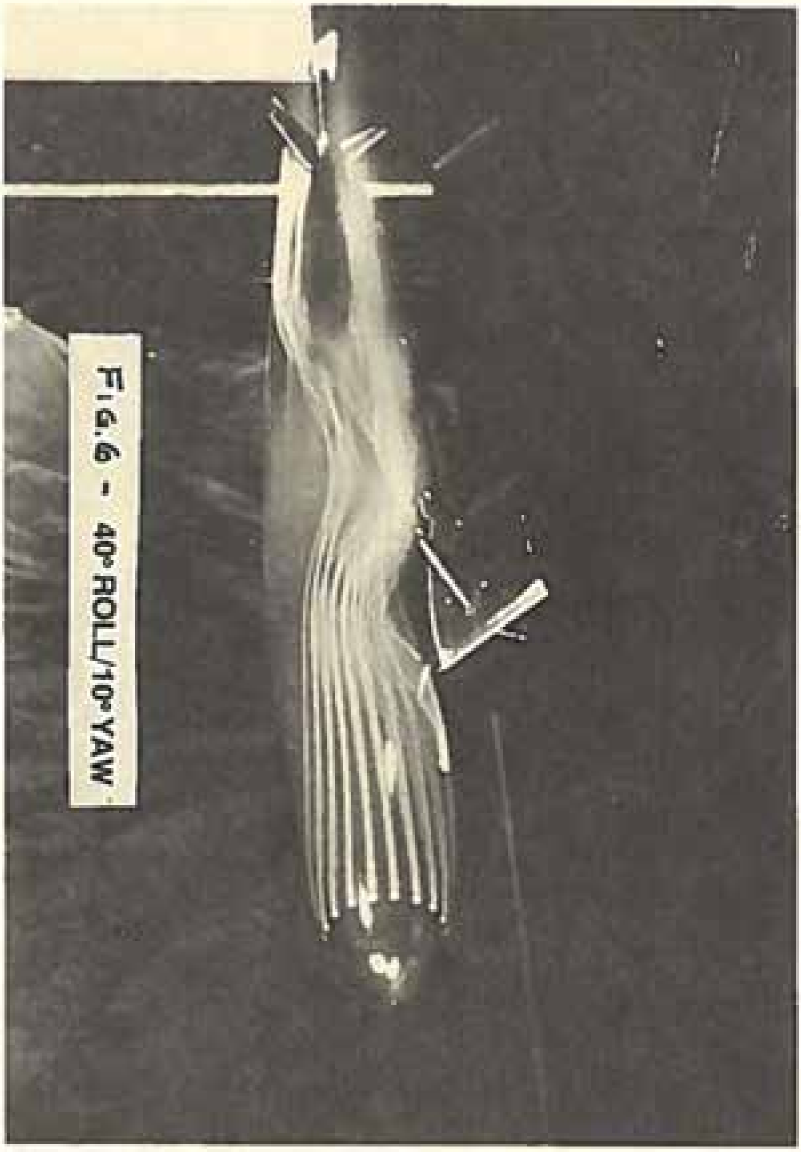

Fig.6 - 40° ROLL/10° YAW

Figure 3. Straight ahead 0° roll/0° yaw.

Figure 4. 10° yaw only.

Figure 5. 10° yaw/20° roll.

Figure 6. 10° yaw/40° roll.

In all of the above photographs the submarine is yawed towards the camera and rolled into the camera.

FIGURE 3:

The low-drag hull design is evident with the flow remaining attached over more than 80% of the body with variations occurring only at the sail and the stern planes. The former is the result of the sail pressure distribution (remember the sail's shape is exactly that of a short wing attached to the hull) while the latter is due to the influence of the stern and rudder planes.

FIGURE 4:

The sail is now developing considerable side force as a result of an effective angle-of-attack of 10 deg. In addition the hull is also developing a side-force as evidenced by the twin vortices which are rolling up inwards (in the classical manner of a lifting body of revolution) towards the low-pressure area at the near-side hull centerline. This side-force is necessary to counteract the centrifugal force of the sub as it progresses through its turning maneuver.

However, the most significant observation here is the manner in which the upper vortex core interacts with the downwash at the trailing edge of the sail. It would appear that the sail's flow-field is attempting to pull the upper vortex away from its normal path and over to the top decking behind the sail. Note that the sail is now developing its maximum amount of side-force or

"lift" which has created a large area of low pressure on the viewer's side of the sub.

FIGURE 5:

With the same yaw angle as before but with a 20 deg. roll angle in addition, the moving of the sail into the region of the twin vortex cores (which are independent of the roll angle, being formed only as a result of the considerable side-force generated by the hull) appears to have caused both vortices to suddenly shift their position on the hull just aft of the sail. This violent flow separation should cause a significant rear pressure shift that would cause a stern-squatting motion with loss of depth and speed.

FIGURE 6:

This very startling flow study accentuates the unsteady flow phenomenon which is characteristic of this maneuver. It is evident that the sail/sail-plane pressure field, in moving further into the bow-generated vortex field, appears to be creating a violent separation on the lower mid-section of the hull. Note that the phenomenon observed in Figs 4 & 5 is an unsteady flow field oscillating at a very low frequency less than 5 hz.

DISCUSSION:

From the above flow studies, it is quite evident that the relatively large sail employed on all U.S. Navy attack submarines has a strong, negative influence on the hydrodynamic flow field that creates the forces generating an underwater turn. With a sail height over 60% of the hull diameter, the sail rolling-moment alone -- at 20 knots -- can be several MILLION foot-pounds. Meanwhile, any upward shift of the hull center of pressure, due to the above vortex instability, would add another 500,000 to 1 million foot-pounds of rolling moment, seriously degrading the transverse metacentric stability of the sub.

On the other hand, the Russian VICTOR, ALPHA, and AKULA class boats all have less prominent sails -- have planes placed deep in the bow, and their sail height appears to be less than 40% of hull diameter -- and the latter two classes have the sail blended into the hull with extensive fairings apparently designed to minimize the sail's influence on the hull flow-field.

Additionally, the above flow separation will result in a higher pressure on the upper rear of the hull which will, in turn, tend to rotate the stern down. This will cause a further shift in the bow-generated vortex which will decrease speed, increase depth (since the sail side-force vector points downward) and further aggravate the degraded attitude of the sub. If, on the other hand, power is increased to counteract the loss of speed and stern-heavy attitude, a possible result would be a complete "barrel-roll", -- which should make things interesting for the crew.

Materially changing the sail shape and size on existing 637 and 688 class boats should not be such a difficult task. For example, the addition of a trailing edge flap on the rear of the sail with an appropriate control system might be sufficient to counteract the above flow difficulties to allow all of our attack boats to not only outmaneuver the opposition -- at any speed -- but also to freely maneuver in shallow waters where smaller subs have an advantage today. Reducing the size of the sail and fairing it into the hull will also provide further quieting of our existing attack boats. The sail-planes have finally been moved down to the hull and moved forward on the most recent 688 class boats and experimental work should continue in this area so that existing boats can be modified to maneuver not only quickly but also quietly.

It is believed that a number of experiments were conducted on the ALBACORE in the late 1950's

with a sail-flap and other control surfaces. Perhaps we should take another look at this data and its applicability towards making our attack boat fleet more effective against the more numerous Russian.

Today's attack submarines need not be saddled with the clumsy maneuvering ability of a Navy blimp. Although slow, quiet stealth has always been an important advantage for our sub fleet, it does not appear prudent to ignore the possibility of underwater "dog fights" in combat. This ability may become even more important as the Soviet attack subs become very quiet as well.

Henry E. Payne III

IN REMEMBRANCE

CAPT CHARLES A. GOODING, USN(RET.)
MRS. R. A. (SUNNY) PETERSON

SOME COMMANDMENTS OF SUBMARINE WARFARE

In Admiral McKee's remarks at the Submarine League Symposium on 9 July 1987, he made the point that there's more to submarine warfare than just ASW, and he challenged the audience to begin an examination of fundamental laws or commandments of submarine warfare. In the course of his presentation Admiral McKee identified what he considered to be four basic axioms:

- o Remain undetected.
- o Shoot first and at short range.
- o Maintain propulsion.
- o Know your ship.

This article uses Admiral McKee's remarks as a starting point to initiate what should turn into an interesting, long-term dialogue in the pages of THE SUBMARINE REVIEW.

Remain undetected. Whether a submarine's mission is strategic deterrence, antisubmarine warfare, antisurface warfare, land attack, surveillance, swimmer delivery, minelaying, transport, or a host of other possible employment options, a submarine has the most freedom of action when no one is certain of exactly where it is. A submarine must have quietness built into it, be properly maintained, and be operated in a quiet, stealthy manner. The Commanding Officer must be aware of the enemy's various means of detecting his submarine and operate so as to minimize all of them.

Shoot first and at short range. The ship that shoots first has the advantage: he has a weapon in the water and the other ship is in a reactive mode. The target ship's immediate concern becomes self-preservation. A counterattack is more of an afterthought and the further away you are when you shoot, the longer the weapon

runs and thus increases its chance of detection.

Maintain propulsion. It's a vitally important concept, but I'm not sure I agree with Admiral McKee's including it as an axiom of submarine warfare: I think it more rightly belongs as "the first law of submarine engineering."

Know your ship. Knowing your ship is the first step in being able to efficiently fight your ship, and it's critical to survival in case of battle damage.

Admiral McKee stopped after discussing the preceding axioms, and challenged his listeners to develop more. Here, then, are several more inputs:

- Know your people, and treat them fairly.
- Know your enemy.
- Train as frequently and as realistically as possible.

Know your people, and treat them fairly. The major difference in performance between submarines is due to a human factor: how well the leaders are leading.

The detailing process results in a random distribution of talent throughout the submarine force. Those ships that do well seem to be superior because their people are better motivated to excel. This motivation comes from positive leadership -- by leaders who are comfortable in positions and who take time to know their people. A man's attitude towards his assignment may be formed before he even settles onboard -- what he's heard about the ship's reputation, what "welcome aboard" help he's received, how smoothly he's checked aboard when he reports, and the impressions he gains as he meets the ship's leaders. Motivating a man during this critical period is

extremely important, but so is a continuing and genuine concern for his well-being and that of his family. The CO, XO and COB need to frequently tour the ship, both in port and at sea, talking with the crew about their specific jobs, and about their concerns. Division officers, chiefs, and other senior petty officers should be genuinely concerned about their people and their equipment. If there's a critical job in progress or some division is working a major project over a weekend, the key leaders should be concerned enough to come to the scene for first hand reports and to lend encouragement (and insight). When your people know you're genuinely concerned about them, they'll go out of their way to meet or exceed your expectations.

Unfortunately, besides strengths, people have weaknesses. A good leader knows the limitations of his people and plans accordingly. A relatively inexperienced OOD should be backed up with an experienced Chief of the Watch. A weak Fire Control Technician of the Watch should be supervised by a sharp OOD, and so forth. Thus, if each watch section is confronted with a similar challenge, they each perform equally as well, since an insightful leader has balanced their strengths and weaknesses.

One item which is extremely important in dealing with a group of people is fairness. Both the appearance and the reality of fairness need to be scrupulously maintained at all times, or the crew will be fractured with internal discontent. There are no secrets on a submarine.

Know your enemy. You have to study the enemy's history, learn the details of his equipment, and try to put yourself in his shoes. Recall the scene from the movie Patton the night before Patton was to engage Rommel in the North African desert. Asked why he was so confident of victory in the forthcoming battle, Patton replied,

"Because I've read his book!" It's too late to learn the characteristics of Soviet torpedoes when sonar reports "torpedo in the water." An ESM report of "Weteye, signal strength four" should elicit an immediate response from an OOD, plus call up in his mind a matrix of possible platforms and their threat to him. Forewarned is forearmed, and the more we learn about our potential enemies now, the safer we'll be in the long run.

Train as frequently and as realistically as possible. The submariners of WW II had a source of motivation we're lacking today -- a lot of their friends had gone out on patrol and never returned. You can't wait to train until a war's about to start, or assume that your firefighting skills carry over from the last underway. The key to successful performance is training, and a prime ingredient in worthwhile training is realism. Unlike athletes, who train to participate in a given event on a certain date, a submarine crew needs to be ready to handle a full spectrum of tactical and emergency situations any time, day or night. If all the fire drills are conducted in the engineroom, how well will the crew handle a real fire in the torpedo room or sonar equipment space? We ought to train and drill as if our lives depended upon it. Someday they might.

I had originally thought about entitling this article "The Ten Commandments of Submarine Warfare," but adding my own ideas to Admiral McKee's still leaves us two short. Are there more fundamental commandments of submarine warfare? I look forward to seeing these themes developed in subsequent issues of the SUBMARINE REVIEW.

CDR Paul J. Ryan, USN

PR FOR SUBMARINES

The world of submarining is for the most part closed to the public. Yet, as we proceed toward the twenty-first century, there is new awareness and desire by the populace to learn of our country's military might.

Present day communications, especially satellite television, have made information more available to more people in a shorter span of time than ever before. All media shares the responsibility for disseminating the journalistic credo, "What, When, Where, Who and Why" and human inquisitiveness demands enlightenment to understand the events of today as well as the technological goliaths which constantly change our times.

Over the years, film, television, radio and the print media have detailed a wealth of information about our ground, air and surface forces -- which far exceeds the miniscule material provided on nuclear submarines. From the birth of NAUTILUS, naysayers greatly reduced all communication links relative to submariners and their machines. Only in the last half dozen years, has there been a glimmer of public relations relative to the Silent Service. A major case in point is the Submarine League and its quarterly publication. Not only is it a forum on submarine matters to those privy to the profession, but more important is its availability to anyone interested in submarining -- a giant step in the right direction. The recent success of the Tom Clancy novel, HUNT FOR RED OCTOBER, soon to be a major motion picture, points out the public's desire and need to know. The public made this story a successful best seller, not the submarine community.

In 30 short years, submarine technology has seen us take immense strides. There are stories to be told, in pictures and sounds -- slices of

life about the men, their families, their philosophies of living under the sea and yes, at times, their dying in this hostile, unforgiving environment. To do this visually, no "top secret" material need be discussed or equipment photographed. Educating while entertaining the masses in a generic manner is the only criterion.

Recently, it was my experience to try and cut through Navy bureaucratic red tape. I was seeking production assistance for a proposed TV docu-drama series. But from all quarters, the answer was the same, "not probable or possible." The upper echelon avoided any discussion. One officer in the Strategic Systems Program Office told me of only one instance of which he knew where a TV news reporter was allowed to embark in an SSBN. A representative at the Office of Naval Information confided that the mind-set of treating the Silent Service as silent, was alive and well by many flag rank officers. He also said that outright hostility by many factions exists toward those outside the submarine family. He added that paranoia reigns high on the problem of "sanitization."

A few months ago, the MacNeil/Lehrer Newshour on PBS featured a two-part story on an attack boat at its homeport -- with a visual brief tour of the boat. An interview also included Vice Admiral Bruce DeMars. To this writer, it was the first meaningful report yet on TV.

Actions akin to those of the PBS effort are needed by the Submarine Service to get the financial and emotional support of government bodies, as well as the public. The sacrosanct mentality of those who would compartmentalize submarining into an ethereal subject must be relaxed. Pictures and sound are far better than words. One only has to watch television news and documentaries to become educated to the world of war. The insouciant public is clamoring for as

much input from the armed services as they can handle.

Short of compromising secret information and submarine machinery, there are secure methods for what I call Planned, Recorded, Edited Productions. Modern technology in the fields of film, videotape and audio with all of their mobil and remote capabilities, have presented the public relations art with still untold prospects. Let us use them to get the message out there! In 1988, it is insufficient to utilize a berthed boat in a static mode to relay that message, nor the use of a phony studio set or old, overused Navy stock footage. A submarine in transit or on-station is the only way to pay proper tribute to the men and boats that go under the sea in harm's way.

Larry Blair

[Editor's Note: The Naval Submarine League is currently in the early phase of negotiation to sponsor a Submarine TV documentary entitled "Submarine Patrol" for airing on PBS and for Navy recruiting uses. It is intended that copies will be available for NSL members use and purchase.]

UNDERWAY ON NUCLEAR POWER

The NSL has obtained VHS and 16 MM copies of the educational film "Underway on Nuclear Power." This 22 minute production centers about the nuclear trained engineers that operate the Navy submarine and surface ships. A good description of each type of ship, its mission and capabilities is provided. William Shatner of "Star Trek" describes the Navy's Nuclear Power Program and the nuclear powered ships. An excellent aid for introduction of the modern Navy to all audiences. Copies of the VHS tapes will be provided to each Chapter. Loaner VHS and the 16 MM film are also available by calling Pat at NSL -- (703) 256-0891.

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Westinghouse has committed a significant force of its scientists and engineers to help fathom the needs of the U.S. Navy's nuclear submarine fleet.

Some of the successes include missile launching and handling systems, which have been installed on every Navy fleet ballistic missile submarine. We're providing the ML&H systems for the TRIDENT II missile and a new system that will allow vertical launches of Tomahawk cruise missiles from Navy attack submarines.

Also, we are currently developing the quietest-ever Main Propulsion System for the next generation attack submarine, and an improved SSN688 class unit.

Westinghouse is developing a sonar system Wide Aperture Array as part of the FY-89 Submarine Combat System, which will allow Navy submarines to rapidly localize enemy submarines.

We produce the transducer array/nose shell assembly for the MK48 ADCAP — the Navy's newest heavyweight torpedo.

Additionally, Westinghouse instrumentation and control systems are installed on virtually all nuclear submarines.

At any level, Westinghouse is helping to fathom requirements for the U.S. Navy's nuclear submarine fleet.

You have our word on it.

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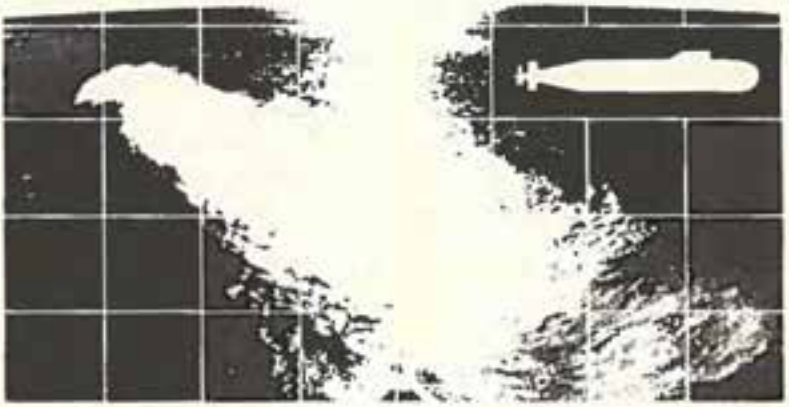
ADVANCING ASW TECHNOLOGY

DRS designs, develops and manufactures defense electronics systems for a variety of applications: sonar signal processors, acoustic video displays, mission recorders and on-board trainers.

Currently operational on hundreds of U.S. and allied naval ships and aircraft, DRS systems are consistently chosen because they are unparalleled in sensitivity and sophistication.

Our reputation for getting the job done on time and within budget has made us a growing force in defense electronics, ASW, intelligence and surveillance.

For more information, contact Richard Ross, DRS Corporate Business Development, Dept. SR, 16 Thornton Road, Oakland, NJ 07436, (201) 337-3800. Telex: 710-988-4191.



DRS

When listening is your best defense

SUBMARINES AND ASW

The Naval Institute Proceedings of October 1987 is devoted to Submarines and ASW. It has articles by six nuclear submariners along with articles by non-submariners on submarine matters. Reviewing all of the pertinent articles and excerpting observations from them appears to be informative to the SUBMARINE REVIEW's readership -- which rarely sees public expressions from the nuclear submarine community. Also, certain interesting generalizations are made about this collection of writings on submarines. (Note: the Editor does not confirm the validity of the quoted statements nor does he necessarily feel that the generalizations which fall out would be a consensus of today's submarine force.)

Submarine Warfare and Strategy

LCDR M. N. Pocalyko, USN, in his Sinking Soviet SSBNs declares that: "tactical nuclear war at sea may exist marginally but is highly implausible" -- and, "the Soviets would not choose a naval tactical nuclear response to our strategic ASW" -- "Soviet SSBNs must be sunk by conventional means" -- and, "Soviet SSBNs are our leverage for ending the war." -- "SSNs operate alone and indeed must operate alone."

LT D. I. Nylen, USN, in his Melee Warfare says that the "high-kill criteria for success of the Maritime Strategy may be out of reach for our SSNs in the future," and "The engagement rate will not be high," -- "The conclusion that must be drawn is that the current high-cost U.S. SSN seems destined to lose its preeminence as an ASW platform in the future."

LT W. F. Hoeft, USN, in his Topfish: Tactics First writes: "effectiveness of the U.S. sub force was based on hypothetical one-on-one engagements between each force's most capable submarine.

CDR D. W. Hearding, USN, in A Call to Combined Arms noted that: "As a result of the erosion of the U.S. technology edge, the mammoth size of the Soviet submarine force has become a more important determinant in the outcome of future submarine war," -- and, "U.S. sub attacks against Soviet submarines operating in consort with other forces will undoubtedly increase U.S. submarine losses."

VADM Bruce DeMars, USN, in an Interview says: "We will have to stop regarding the submarine strictly as an ASW weapon." -- and, "Don't ever take your eyes off the fact that submarine warfare is stealth warfare." As for the Soviet bastion concept, "I think it is clearly their current concept because of implications of our Maritime Strategy."

Submarine Tactics

LCDR Pocalyko says, "nuclear war is a Soviet option only of last desperate resort."

LT Nylen feels that in a melee "the engagement now seems somewhat even." -- "Depth capability, where the Soviets again exceed the U.S., aids a submarine in avoiding the vertical width of the torpedo's acoustic cone." -- "Speed, in which the Soviets excel, also helps a submarine evade the homing torpedo." -- "The submarine can be an effective ASUW platform, but its vulnerability once detected -- may preclude this from becoming an important mission."

CDR K. J. Reardon, USN, in his Ensuring the Undersea Advantage says: "The top 3 characteristics of an SSN are quieting, quieting and quieting." Also, "The SSN-21 will provide a revolutionary breakthrough in underwater stealth."

LT Hoeft notes that "the tremendous routine workload submariners face on sea duty diverts

their attention away from their individual tactical proficiency."

LT T. J. Belke, USN, in Pushing the Limit notes that, "The submariner who thinks the primary advantages of stealth and concealment are inviolate courts disaster," -- and that "we promote blind faith in our cloak of invisibility." -- Also, "Even shots that miss yield dividends because they put your opponent off balance and on the defensive."

C. T. Urban in his Bringing Tactics to the Surface says: "Attack submarine wardrooms consider themselves tactical experts..... . However, the allotted time within the larger scheme of things relegate tactical training to more of a hobby." "Today there may be too much misplaced trust and dependence on combat system and weapon capabilities."

VADM DeMars says, "We have the potential to perform antiair warfare to a certain degree -- and help the battle group with our ability to launch antiair missiles from covert positions."

Weapons

LT Nylen writes: "the Soviet's sonar system would certainly pick up the noisy Mk-48 torpedo within seconds of its launch."

CDR Reardon says, "Unfortunately, U.S. torpedo developments have not kept pace, ... while, "The Navy currently has no anti-torpedo defense system."

VADM DeMars notes that, "rather than making our heavyweight torpedo warhead better, we are making our lightweight torpedo better." -- "A new torpedo program? Eventually -- but I don't have the money right now." -- As for whether our torpedoes can defeat the threat, "Obviously I think so

or we'd be working hard to change the heavyweight torpedoes."

Personnel

LT Hoeft notes: "The submarine force is losing far too many good officers who expected to contribute to a cause but found themselves -- jerked around -- and overworked by confused and competing priorities." ...."The Engineers Exam ensures that uniformly competent officers are supervising the propulsion plants of nuclear submarines -- no equivalent challenge exists for individuals to prove their tactical competence." -- and, "Although an attitude of invincible arrogance pervades the submarine community, few submariners have the first hand knowledge to justify such an attitude." ... "Officers find themselves pursuing 'urgent' tasks that have no apparent relationship to ship safety or wartime readiness, and they become disillusioned."

LT Belke says that "Some nuclear-trained officers without SSN experience are eventually assigned as executive and commanding officers with as few as 5 OOD watches under their belt." ... "Since GSOs have stood the lion's share of OOD watches in SSBNs for two decades....there are....a number of nuclear trained officers with dangerously little shiphandling experience and only a shallow knowledge of their boat's capabilities."

C. D. Urban feels that, "Unless retention improves drastically there will never be enough second-tour officers to have significant impact on working conditions."

CDR Hearding points out that "The current level of experience and expertise in combined arms ASW operations is low."

Generalizations

- There seems to be scant belief within the submarine community that tactical nuclear weapons will see any use. Therefore, there is little regard for how they might change submarine strategy and tactics.
- All present weapons, including those air-delivered, are felt to be "lethal" against Soviet submarines despite their widely spaced double hulls.
- All submarine writers appear to take it for granted that the U.S. still holds the initiative against the Soviet submarine force. The corollary to this is that the U.S. SSN is the best submarine in the world today. VADM DeMars confirms this, saying: "I think we probably dwell too much on R&D and modernization .... It is the area that I put the least percentage of my money into."
- "Avoid detection" -- a dictum of the submarine force -- is apparently a paradox. The articles show that for SSBNs this is absolutely correct; for SSNs it might seriously reduce their usefulness in combined operations. Specifically, LT Nylen says: "U.S. submarine groups would force individual subs to give up covertness."
- Tactics are much discussed but there is little definition of what they are. Certainly, there is little recognition of how submarine weapons are being used and how they affect tactics.
- How the Soviets might destroy or counter our submarine weapons before their arrival on target seems to be lacking.
- There is a general recognition that all enemy submarines may be quieter than in the past -- at least at low speeds. VADM DeMars recognized that, "Designing a submarine to be quiet at slow speeds is relatively easy nowadays."

LETTERS

The eulogy to Frank Lynch in the October SUBMARINE REVIEW doesn't begin to describe the importance to the Navy of this truly innovative thinker. I was fortunate to work with him at Electric Boat Co. in the Advanced Engineering Planning section -- and to help develop some of his highly creative ideas. Recalling a few of his projects can give one a better idea of the stature of this submarine-dedicated man:

- He proposed a tube-launched missile with nuclear warhead, first as a strike weapon, then as an ASW weapon, and saw the idea brought to fruition with the production of the SUBROC nuclear ASW weapon.

- He pioneered the submarine integrated fire control concept, forcing a shift from analog to digital to make it feasible -- and then was instrumental in making it happen.

- He was the father of the K-boat concept (Jimmy Carter served in one) and later pushed the gas-turbine-powered conventional submarine -- which never materialized although it had some very big plusses. He also proposed and conceptually designed a monitor-type submarine with 11 feet of syntactic foam between the outer and inner hull -- a submarine which would be invulnerable to the largest of conventional warheads, whether bombs, torpedoes or mines.

- His political/military sense was unusual. As an avid subscriber of the Peking Daily, his studied readings led him to urge a rapprochement with Red China well before President Nixon's overtures. He saw this act as a viable offensive against Soviet worldwide imperialism. Similarly for strategic weapons, he was an early advocate of the "zero option."

His loss was a great loss to the Navy.

John S. Leonard

WAHOO

In the book review of WAHOO in the October 1987 issue, THOR asks rhetorically what produced [WAHOO's] sensational results. Specifically, was it Morton's personality ...leadership...tactics? Let me give my answer.

The change in WAHOO after Morton took command was instantaneous and dramatic. Unwarranted caution, hesitancy, self-doubt and lack of trust in officers and men were replaced by aggressiveness, positiveness, belief in self and faith in those who manned WAHOO. How did Morton do it? Simply by stamping his personality on every officer and enlisted man, a personality that radiated valor, commitment, professionalism, loyalty, patriotism and optimism. When these personal traits were put to the test, Morton was not found wanting.

I know no better way to achieve results; in essence, to lead.

Rafael C. Benitez

'87 FACT BOOK

In the '87 FACT BOOK p. 31 -- if you ever republish in another year -- I suggest you revise our list of Aces. I realize some postwar figures are bound to be inaccurate -- and are. Clay Blair, good as his dope seems, has missed a patrol or two. Some JANAP stuff is inaccurate. ADM Chick Clarey has found 2 more sinkings by PINTADO that were never credited, etc.

Karl Hensel

THE SUBMARINE OFFICER'S MANUAL

I have just completed a preliminary outline for "The Submarine Officer's Manual." The manual will present a young submarine officer with an overview of what it takes to be a successful submarine commander. The manual would represent the type of basic document that I wish someone had given me about the time I put in my request for submarine duty.

I want our young officers to focus their efforts on becoming submarine commanding officers from their first days at sub-school, or even prior to that. Then I want them to realize that to do that they should be WARRIORS with some added attributes which will make them able to take the command role as a leader of their submarine team. I also want them to know, right from the start, that the next naval war may well be a nuclear war. If they aren't prepared for that they should stay back in Peoria and run for mayor, manage the local grain mill, or sell gasoline. I also want them to realize what it will be like out there at sea, with no one to give them directions, repair the air compressors, stop the leak in the engine room, bale out the flooded motor room, and get things working again with all major electrical circuits grounded. I want them to contemplate the pleasure, pride and excitement that comes with success in battle. To accomplish this, I want to provide vivid descriptions of casualties and successes from WW II experiences. These young officers must be made to realize that to make attacks and handle major casualties they will have to know the boat in detail as well as many other things, and they will have to see that their subordinates, both officer and enlisted, know their stuff. In short, they must be the owner, trainer, manager, and also the captain of the football team. And sometimes they must be the water boy too.

William P. Gruner

WAHOO

This has turned into a month of memories of submarines in World War II. It started with my receipt of Dick O'Kane's latest book, WAHOO, and then "Thor's" review of WAHOO in October's SUBMARINE REVIEW.

I take exception to Thor's comment: "Of the thirty-seven American submarines lost without survivors during World War II, only WAHOO's end is known," -- an apparent paraphrase of O'Kane's statement on page 333 of WAHOO i.e. "Sadly, from thirty-seven other submarines, bringing the total to fifty-two, there were no survivors, and their brave stories, except for WAHOO's, we shall never know." Loss of one additional boat, and a great one at that, HARDER, with Sam Dealey in command, was quite clearly established.

A review of the report of HAKE's 6th patrol (with CO Frank Hayler) shows:

8/23/44	2308	Rendezvous with HARDER. Exchanged information. Made plans to finish off DD damaged by HADDO. HADDO had left area for resupply.
8/24/44	0453	Dive for submerged approach.
	0532	Pinging at 180 T.
	0554	Sighted tops of 2 ships at 183 T and 173 T.
	0622	2 ships on course 030 speed 14.
	0636	Target-range 6500. They zigged into Dasol Bay. Escort stayed outside.
	0646	Broke off attack.
	0647	Sighted HARDER's periscope at 700 yards, bearing 000 T.
		Changed course to 180 T.
		Heard three pings from escort - took a look. Escort broad on our port quarter - angle on the bow

45P and swinging toward us at 2000 yards.

0710 Went deep, rigged for silent running. Escort apparently has two targets and is confused.

0728 15 rapid depth charges - none close.

0732 Took evasive action. They seem to have us located.

0830 Joined by another escort. He tracked us but no depth charges.

0955 Screws faded.

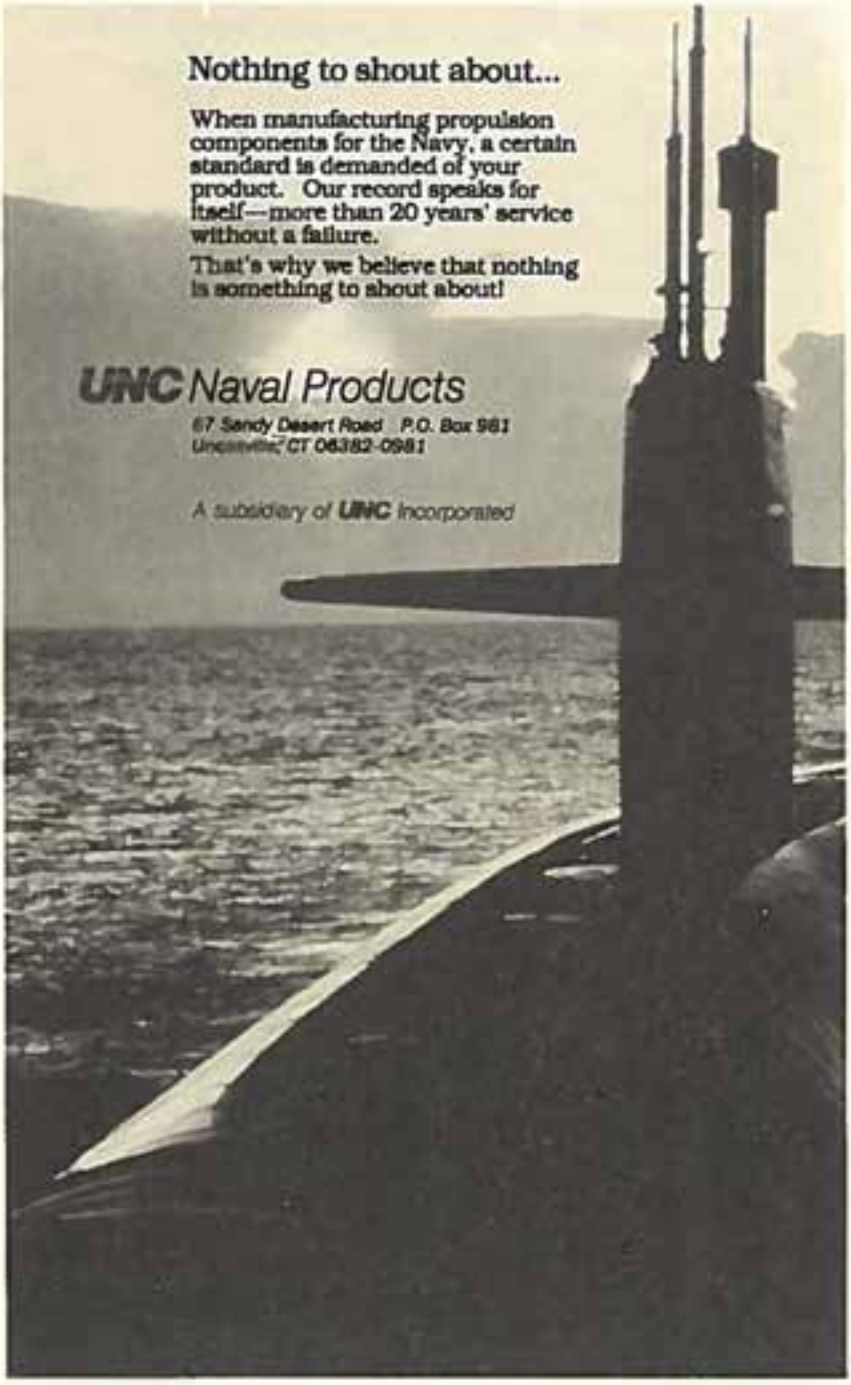
1030 Secured from silent running.

We never heard from HARDER after the above encounter and I believe that the depth charging at 0728 is conclusive enough proof. The aggressive tactics of Sam Dealey were such as to place him in harm's way.

Dick Metzger

PIGGYBACK REUNION
at the 1988 Symposium

USS STICKLEBACK (SS-415)
8 June 1988
Contact Bill Greenlaw, 476 Lymington Rd.
Severna Park, MD 21146
(301) 544-3514.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IN THE NEWS

o SUBNOTES/ September 1987 says that "to date Atlantis tourist subs (operating in Caribbean waters) have had more than 2,500 dives while taking over 50,000 passengers to explore reefs and sealife. Each sub holds 28 passengers." The new Atlantis III, which will carry 48 people, will operate from St. Thomas in the Virgin Islands. In commenting on "the expanding tourist sub business," the head of Winchester Associates Ltd. in Aberdeen says, "We don't approve at all of these large single hull designs with no means of restricting flooding and are surprised the U.S. Coast Guard hasn't stopped them from being used."..... "unlike others, ours (new tourist subs) have watertight and pressure tight compartments to restrict water ingress to one area and preserve buoyancy."

o Admiral C A. H. Trost, USN, said at COMOPTEVFOR's Change of Command on 6 August, 1987:

> "Today we are on the verge of a new epoch. People talk about the coming revolution at sea: It's true .... at least in concept. If we were to visit the NOB piers this afternoon, we would see the navy of the 1950s, 1960s, 1970s and 1980s. But if we were to go inside the headquarters building to my left, we would see aspects of the navy of the 1990s and beyond. The potential breakthroughs in technology that lie just ahead, if only we can capture them in a practical, affordable way, make the vision of the navy of the future something to behold indeed.
>
> Let me give you a glimpse: Ships powered by superconducting electric-drive motors; hypersonic airplanes capable of exiting the earth's atmosphere, docking in space, re-entering, and recovering on board futuristic aircraft carriers; submarines performing

roles unheard of today; sensors that provide total surveillance of the battle sphere; directed energy weapons that never need reloading.

All these are dazzling prospects. But their realization depends upon a spindly, narrow footbridge suspended between the twin peaks of the laboratory and the field. In the years to come, thousands of ideas will try to make the trip across that bridge. When ideas work, when the navy can take them to sea and fight and win with them, then you must help them make the trip across the bridge as expeditiously as possible. But when they don't work, then you must not hesitate to snatch them up.... and throw them bodily into the gorge below."

o Aviation Week & Space Technology/Sept. 28, 1987, notes that two Navy Transit navigation satellites were placed into polar orbit on Sept. 16th, bringing to 9 the total of Transits used by submarines for their navigation.

o The Washington Post of 20 October, tells of a plan to sink the Navy's SS BLENNY in waters off Ocean City, Maryland, to serve as a reef to nurture underwater sealife. "Maryland has been struggling to increase the population of fish in state waters." Sinking submarines near Ocean City will attract and keep fish in that area.

o In an article in NAVY NEWS & Undersea Technology of 9 October, it is noted that "The U.S. has refused to let Canada build a U.S. design submarine, as Canada preferred," and "could veto a Canadian decision to build the (British) TRAFALGAR.... whose nuclear reactor is based on U.S. technology transferred to Britain in 1958. Under the terms of the transfer, the U.S. has a say over any British attempt to sell the technology to a third party."

o Also, in the same edition of Navy News is a note on the MK 50 lightweight, anti-submarine torpedo -- SEA LANCE -- a submarine launched missile-delivered torpedo. Now undergoing tests, SEA LANCE is expected to be operational within three years. This program has been delayed in the development stage for more than a year while Honeywell (the prime contractor) engineers "have labored to meet size and weight requirements."

o Janes's Defense Weekly of 17 October, reports a successful firing of the TRIDENT II (D-5) ballistic missile and notes that this missile's first submerged test firing is scheduled for 1989. "About 13 more land launches are planned before the tests from submarines start."

o The Washington Post of 24 October reports that "a team of five trained bottle-nosed dolphins.... to be used for mine-hunting and detection of underwater divers and swimmers" have been added to Navy security forces in the Persian Gulf." The five dolphins which arrived in the Gulf Oct. 13, were trained at a Navy research laboratory at Point Loma, San Diego."

o The Proceedings/November 1987 tells of a present Department of Defense contract with Aquanautics "to build an artificial gill -- a chemical device to extract free oxygen from sea water -- for an un-manned, long endurance submersible vehicle." This device would be like a fish extracting the dissolved oxygen in sea water by passing the water through its gills. Since oxygen as a fuel has a much higher energy density than batteries, using this device will provide far greater endurance "than a battery-powered equivalent."

o The Navy Times of 2 November says that a House-Senate conference committee has tentatively approved a 35 percent increase in submarine pay. This could mean as much as $100 extra per month

for eligible officers. This raise in submarine pay plus other measures are expected to help stem "a continuing slide in officer retention and recruiting." The submarine force appears to be 100 officers short of its 622 recruiting goal, and officer retention is down to approximately 40 percent.

o The Washington Post of 7 November in an article authored by Walter Pincus, tells of delays in testing a TRIDENT II (D-5) missile with 12 dummy warheads -- and the debate created by the testing of this missile configuration. Under the rules of SALT I, when such a missile is finally deployed in a TRIDENT submarine, all strategic missiles carried would be counted as 12-warhead weapons. Thus, with START's (strategic arms talks) 50 percent reduction, a cap of 3500 submarine-launched warheads would cause the U.S. to be limited to having only 12 TRIDENT submarines. (Each TRIDENT carrying 24 missiles would then be assumed to have 288 warheads on board.) The Navy presently has 8 TRIDENT submarines deployed, with 6 more under construction, another budgeted by the Congress, and an eventual planned force of at least 20. A delegation of 45 Senators have urged the President to delay the 12-warhead test, saying that the test "may well weaken the U.S. strategic force posture" for START deliberations. The TRIDENT IIs, to be first deployed in 1989, will carry 8 large MK 5 warheads. A later version may carry 12 smaller MK 4 warheads -- to be used against softer strategic targets.

o Sea Technology/October 1987 reports that Admiral Chernavin, Soviet Navy Commander-in-Chief, in an interview with the newspaper Izvestiya said that the Soviet Navy was "taking every necessary step to improve the quality of its nuclear submarines rather than their numbers."

o In the same edition of Sea Technology it is pointed out that an investigation by the

Norwegian Kongsberg company came up with the findings that the export of their computers along with the Japanese Toshiba milling machines to the Soviet Union "almost certainly contributed nothing to the quieting of the propellers of the Soviet SIERRA and AKULA class SSNs. The first SIERRA was launched in July 1983 and the AKULA in July 1984. This would make it unlikely that the improved Toshiba methods of milling the propellers had been used in their construction -- rather that "the Soviet Union had silent propellers before the equipment was delivered by Kongsberg and Toshiba between April and July 1984. However, it is apparently evident that about 200 SSNs and SSBNs plus large numbers of conventional submarines could be provided silent propellers with the help of the Kongsberg-Toshiba exported technology.

o A UPI release in September tells of VADM Bruce DeMars' desire "to develop new classes of submarines that use laser and satellite technology to shoot down enemy aircraft and bombard enemy shores." DeMars sees the use of the $100 million R&D money in the House 1988 defense authorization bill "to build experimental prototypes for possible new classes of submarines." Anti-aircraft and shore bombardment nuclear submarines are apparently envisioned. For either air targets or mobile land targets, missiles launched by a submarine "could be radar guided by satellite, surface warships or even 'some guy sitting on a hill in Europe.'" DeMars is also quoted as saying that "satellites using laser beams now hold promise of solving the communication problem and providing submerged submarines with sufficient target information and intelligence to hit mobile land targets such as tank formations and aircraft."

o A new long-range surveillance sonar for the protection of harbors and offshore assets against underwater swimmers and small submersibles -- the AS370 made by UDI Group Ltd -- is presently

undergoing Swedish evaluation trials. This sonar can detect underwater swimmers out to 500 meters and small submersibles to a range of 1000 meters. Multiple underwater sensors can form a complete intruder protection system.

o Janes's Defense Weekly of 24 October 1987 tells of the Polish Navy replacing their old WHISKEY boats with the new Soviet KILO class diesel-electric submarines -- for use in the Baltic. The KILOs displace 3,200 tons, have a teardrop shaped hull and make about 25 knots submerged. Their increased maneuverability makes them more effective for shallow water operations. The appearance of these KILOs in the Polish Navy indicates "that the Soviets wish to encourage the Poles to bear more of the naval burden in the Baltic.

o An article in Navy News & Undersea Technology of 9 October relates that "Despite overwhelming test success, Navy Secretary James Webb has killed the low-cost (about $200,000) antiship torpedo and will not submit a congressionally ordered report on the test results." However, "torpedo enthusiasts hope that political factors beyond the Navy's purview may yet save the Italian-made (WHITEHEAD) weapon that passed sea trials with flying colors." Webb's decision, it was reported, was based on the low priority of the operational requirement for a submarine anti-surface ship torpedo, plus a belief that "there are significant unknowns in interfacing this foreign-made torpedo with existing submarine systems." However, in later action by the House Appropriations Committee, Secretary Webb's order to kill the anti-ship torpedo was contradicted and the Navy told to continue the testing of the WHITEHEAD A 184 electric torpedo, while ordering the Navy to spend up to $10 million to procure 27 such torpedoes for follow-on test and evaluation. The tests will show the compatibility of the A 184 with U.S.

submarine fire control systems and how well the warhead works. In addition, the committee noted that the Navy had not submitted the report on the torpedo which was due in May. And therefore, the Committee forbids obligation of any of the recommended amount for submarine tactical warfare systems ($35 million) until 30 days after submission of the report, including in-water test results."

o The same House Appropriations Committee report of 28 October recommended "$112,899,000 for Attack Submarine Development," an addition of $100 million to the budget request authorized by the House. Based upon the threat, the Committee believes that work in a number of areas should be significantly accelerated: in advanced submarine hull, mechanical and electrical (H M & E) technologies such as boundary layer control, compliant coatings, advanced materials, automated control systems and structures, and advanced propulsion systems -- but not for sensors or weapons development. Funding of at least $100 million in FY '89 "to continue this effort" is called for. And, "the Navy is directed to apply $11 million to continue its investigation of new battery technology." The Committee "also recommends $15 million, not included in the budget, but authorized by the House, be spent for shipbuilder and Navy concept studies for improving the SSN-688 class.

o NAVY NEWS & Underseas Technology of 6 November notes that Navy Secretary Webb has approved production of 150 MK 48 ADCAP torpedoes. The ADCAP was scheduled to enter the fleet inventory in 1983/84, but delays pushed this back to the late 1980s. Operational testing of ADCAPs at sea will begin in December with a batch delivered by Hughes during pilot production (of 100 torpedoes).

o In the same issue of Navy News, an article bylined by Elli Bessner tells of a ride in October by Canadian officials on a TRAFALGAR-class nuclear submarine -- the TORBAY. The officials thought that the British SSN TORBAY "was a tremendous piece of technology, and so impressive that it is going to be a tough act for the French to follow." A choice is to be made by Canada between the British TRAFALGAR type and the French RUBIS for a planned 10-12 Canadian nuclear attack submarine program. Canada anticipates that the Americans will agree to release the technology for the British nuclears. The French RUBIS submarine is priced at approximately $350 million and the TRAFALGARs are about $500 million per submarine.

o Defense Week of 13 October reports that a British-designed and built by the British nuclear reactor -- is running at full power and was completed a few days ahead of its 5-year schedule and within its $500 million budget. This Rolls Royce and Associates-built PWR2 reactor is twice as powerful as any reactor previously built by the British. It will be used in Britain's four TRIDENT-type SSBNs. It has, according to its designers, "new safety features in its forged pressure vessel, reduced noise from cooling pumps, greater shock resistance under attack and less maintenance."

o Defense Week of November notes that a submarine-launched TOMAHAWK cruise missile "successfully demonstrated a conventional submunitions land attack capability -- using a live warhead in a test conducted on San Clemente Island." The missile flew about 500 miles, and along the way hit several targets on the island with live combined-effects bomblets, before diving into a simulated target on the island."

o INSIGHT/November 9, 1987 reports that Swedish ASW forces are hoping the U.S. will

develop antisubmarine torpedoes which "are suitable for use in relatively shallow waters -- and which could aid the Swedes in defending their coastal areas against penetration by Soviet submarines." It is noted that the penetrations appear to be made by smaller Soviet submarines and that "most existing ASW weapons are intended for use in the open ocean with its greater depths."

o The House Appropriations Committee calls for expenditure by the Navy of the $39 million appropriated for a satellite-to-submarine laser communications capability. Although the Navy plans to test, in 1988, blue laser communication to submerged submarines, the Committee appears "skeptical about the Navy's commitment to laser communications" -- having spent only $11 million of the $20 million appropriated last year. Accord ing to Representative Young (R-Fla.), "I get the feeling that you (the Navy) are not putting the emphasis on the program that my colleagues and I hoped you would." A Navy plan for the development and deployment of a laser communications system (to ballistic missile submarines) is called for.

o In a recent talk to NSIA's ASW Committee, Admiral Carl Trost, the Chief of Naval Operations, delivered these remarks -- amongst others -- about the Navy's use of space:

> "At a time when space technology is almost begging us to use it, we are still wrapped in our earth-bound security blanket. We are thinking in terms of the millions of square miles of opaque ocean when we should be thinking in terms of a planet seen as the size of a basketball.
>
> "We are falling farther behind in a space race that affects not only ASW and naval warfare but our very national security. Today we know that in wartime, even in a conventional war of limited duration, the two

superpowers would fight a battle of attrition in space until one side or other had wrested control. The winner would then use the surviving space systems to decide the contests on land and sea. Today, that superpower would probably not be the United States. Despite our successes in the past, despite our superior technological base, we are today farther behind the Soviet Union in the military application of space technology than we were when SPUTNIK first went up.

"In short, the Soviets are prepared to go to war in space, and we are not. They've thought about it; they've developed a competitive strategy that exploits their advantages; they've procured the hardware to execute that strategy; they're organized; and they're getting better. In 1986, they spent 30 billion dollars on space to our 18 billion. They conducted 91 launches to our 9. More than 90 percent of their missions, manned and unmanned, have supported military operations. For our part, whether our space station is even to have a military mission has become an international cause celebre. In numbers, flexibility, and redundancy of satellites; in survivability and reconstitution of space systems; and turning the coin over, in anti-satellite weapons, the Soviet Union has deployed what we are still discussing.

"I submit to you that notwithstanding all our other efforts, mastering space is the key element in preserving our lead in ASW -- and ultimately our ability to defend the sea lanes and project power where and when required. We have got to do a better job.

"Given our current and projected funding levels, that's a tough proposition. I am sure you get as tired as I do of being

enjoined to "Do more with less." There are, however, certain things we can do right now to improve our performance, both in space and in the other areas of ASW that make such a difference to our capability.

"In closing, with regard to space, we've got to stop being squeamish, and we've got to start thinking ambitiously and innovatively. The Soviet Union, whose international objectives are by no means as high-minded as ours, has no scruples about putting weapons in space. We need to reorient our thinking. It only makes sense to build all our systems -- and particularly our ASW systems -- impervious to jamming, interference, interception and to any other countermeasures that might be used against them. This means hardened systems, achieved by heavy lift. It means deploying them far enough into space that an adversary would find it unrealistic to try to intercept or interfere with them. And it means deploying enough satellites to be sure that no matter what countermeasures were used, some would survive to remain dedicated to protracted naval warfare. Or perhaps it means accelerating the efforts to develop simpler, lower-cost systems in greater numbers that could be reconstituted in times of crisis to ensure continuing capability."

o Navy News & Undersea Technology of 20 November, reports that a panel of the House Armed Services Committee staffers "will investigate how good Soviet submarines are compared to U.S. submarines." The panel hopes to reach its conclusions before Congress acts on the FY '89 defense budget. Anthony Batista, the staff director of the House Armed Services R&D subcommittee, and who led the push for this submarine panel, said about the submarine balance, "I'm scared to death. I think the SSN-21 is not good enough, in relation to the next generation Soviet subma-

rines." Earlier, the Navy had said that "the SSN-21 will restore U.S. submarine superiority to the wide margin enjoyed in the early 1970s." But the R&D subcommittee is worried that more advanced technologies than those in the SEAWOLF may be required. "The seapower subcommittee, however, has felt that the SSN-21 can overcome the threat posed by the new Soviet AKULA-class submarines."

o An article in the Washington Post of 3 December by Brent Scowcroft, John Deutch and R. James Woolsey, discussed "the survivability problem" for our strategic nuclear defense forces. It is noted the "Eight or so submarines (SSBNs) are very few baskets in which to put the nation's entire survivable nuclear deterrent." This is based on the assumption that a 50% agreed upon cut in strategic warheads would then limit the U.S. to 12 SSBNs with about 8 on patrol at any one time -- because the Navy's testing of a 12-warhead TRIDENT II would cause each SSBN to be credited with carrying 288 warheads and 12 TRIDENTs would involve almost all of the 3600 warheads that would be allocated to this part of the Triad of strategic defense systems. But, "this is especially alarming when one looks at a Soviet force of well over 100 nuclear attack submarines that could threaten this handful of TRIDENTs." And "given the march of technology, the 1990s will bring serious vulnerabilities for the bombers on their bases and for nonmobile ICBMs" (since the Administration is not pushing for the mobile ICBM). Thus, as a result, "in the relatively near future, there will be vulnerable landbased ICBM and bomber forces and only a few submarines to carry our whole strategic deterrent." And that rather than a 50% reduction in strategic nuclear warheads producing a more stable form of deterrence, the opposite is more likely to be true.

o A commentary in SIGNAL, November 1987 by Admiral Jon Boyes says: "More command, control and communications capabilities were added to Soviet

strategic and attack submarine forces with the activation of three extremely low frequency (ELF) (40 to 80 hertz range) radio stations in the Soviet Union. These stations outpower and reliably outdistance the sole, small U.S. ELF station, (used to transmit messages to distant submarines at great depths). ELF gives the military and political leadership a better degree of control."

o The oldest (29 years old) nuclear submarine in commission, the USS SWORDFISH (SSN 579) was finally deactivated on 19 November at the Naval Submarine Base, Pearl Harbor. The President of the Naval Submarine League, Vice Admiral Shannon D. Cramer Jr., USN(Ret.), the original Commanding Officer of SWORDFISH, was the keynote speaker at the deactivation ceremony. The present CNO, Admiral Carlisle A. H. Trost, was a member of the original SWORDFISH complement and qualified in submarines while on board. Last of the SKATE class to be deactivated, SWORDFISH logged more than 500,000 miles.

NOTICE

A supply of the official NSL Lapel Pins is now available at the Submarine Force Museum. The cost is $8.50 each. Please send your orders and remittance to:

Submarine Force Library and Museum
Box 501, Naval Submarine Base
Groton, CT 06349

You may also want to ask for a copy of their Gift Catalogue. It contains many excellent gift ideas.

BOOK REVIEW

TAKE HER DEEP

by I. J. Galantin, Algonquin Books, 262 pages

This memoir of World War II submarine operations written by a gutsy skipper describes his ship's company's experiences in carrying out their mission in the Western Pacific during that stressful time. Their ship, the USS HALIBUT, was a "Fleet Submarine" of which there were too few in our Navy in the early days of the war in the Pacific. The HALIBUT was an early member of that class. Its main armament consisted of ten torpedo tubes, six in the bow, and four in the stern, and fourteen reload torpedoes. It had one 4" gun on the main deck, and two 20 mm guns along with two 50-caliber machine guns on the "cigarette deck." This was "the boat" that patrolled the Western Pacific, attacking Japanese men-of-war and merchant shipping, performing "life guard" and other duties "as assigned" until, in HALIBUT's case, it was subjected to the heaviest attack any of our submarines survived, and returned to port as evidence of the survivability of this type of double-hulled submarine.

No one should plunge into Admiral "Pete" Galantin's story without first reading his notes on pages XI and XII. They explain who the expected audience was for this account of historical submarine events. Pete's main objective was to give the officers and men who served under him a documented record of their experiences -- during probably the most demanding and exciting period of their lives. Secondly he was writing for two other categories of readers: those conversant with diesel submarine operations and capabilities, and the uninitiated who know little about the old submarines but are still interested in what they did in World War II. Unfortunately, in trying to accommodate the latter category of readers, he had to describe submarine construction, capabilities,

equipment and tactics well enough so that the uninitiated could follow the story he has to tell -- and do this without boring the Dolphin wearers. I must admit that though he has done this admirably, I pretty much skipped over these time-worn basics of the fleet boats. Perhaps a joint assessment by all the types of readers would give a more supportable opinion of how this book satisfies their interests.

Submarine warfare during WW II has been described by some observers as "long periods of utter boredom punctuated by brief intervals of sheer terror." I don't remember the "sheer terror" bit, nor do I remember being greatly bored by the war we fought out there in the Pacific against the Japanese -- in submarines. But it could be more applicable to HALIBUT's patrols, where they had a bit more frightening experiences. Admiral Galantin's account lends a little more credence to that quote. One of the officer's -- who was transferred to HALIBUT from an S-boat for her final patrol -- said that when the greatly destructive attack started, he looked around him to see if the others were scared, because he wasn't sure that fleet boats didn't normally react like that to a depth charge attack, or whatever it was slamming them. One look and he was convinced the HALIBUT was in real trouble. He also noted that despite the great concussive effects and severe damage created, none of the crew had broken legs, ankles, wrenched spines or anything comparable, and that only one man was sedated because of the "terror" he felt.

Admiral Galantin has given us a detailed account of the state of submarine warfare in the Pacific including the faulty performance of the pre-war produced torpedoes -- which made for dangerous and very frustrating situations. He also gives us an appreciation of the new weapons and equipment that were then brought into usage after the first year of the war -- the improved

Mk14s, the electric Mk18s, the IFF feature for the radars which identified friend from foe, etc.

By including accounts of refit and refresher training periods, and by making reference to mail from home and family relationships of his crew, he has tactfully made the point that his ship's company was a closely knit team of sensitive and very human young men. This puts the grueling experiences of the patrols in a realistic context.

The skipper, Galantin, carries us through the successes and disappointments of HALIBUT's patrols with complete candor -- questioning his own decisions and pulling no punches. It is an enigma that this skillful and seasoned commanding officer and crew should become the victim, and perhaps the only known victim, of a particular advance in Japanese anti-submarine technology for which they had no forewarning. Later, it appeared that intelligence people might have had some inklings of a magnetic anomaly detection capability in Japanese ASW aircraft, and that this might have been the cause for such a swift and accurate attack on HALIBUT using bombs or depth charges. This severe attack occurred on the last patrol of the HALIBUT -- her tenth, and Admiral Galantin's fifth in a row. The materiel damage sustained appears to have been the greatest for any surviving submarine, and was so assessed by Admiral Lockwood on HALIBUT's return to Pearl Harbor. Her pressure hull was dished-in in several places, her generators were knocked off their blocks -- and then there was a severe explosion up in the forward battery causing both the battery compartment and the forward torpedo room to be closed off, isolating the men there. HALIBUT was consequently put out of commission, ending her war.

"Take Her Deep" is a thrilling recounting of a submarine's service to our country. Two centuries earlier John Paul Jones said that he

intended to take his ship "into harm's way." These guys did just that, and we are thankful that they got back to tell about it.

Jim Andrews

REMEMBERING THE NAVAL SUBMARINE LEAGUE

As you have your will drafted or revised, we hope that you will remember the Naval Submarine League. It is through your continuing support that the Naval Submarine League will be able to grow and make a difference and contribution to enhance the public's support for the Submarine Services.

There are many different ways to include the Naval Submarine League in your will. You may want to make an outright bequest of cash, stock or other property to the Foundation. Or, you may prefer a plan that would first provide for the benefit of your family members during their lifetimes, after which time certain designated assets of yours would be distributed to the League. It is also possible to name the Naval Submarine League as a contingent beneficiary. For example, you may provide for the League to receive cash or other property from your estate only if others named in your will are not living at the time of your death.

We would be pleased to provide you or your attorney with more information on how you can support the Naval Submarine League and its work through your will.

Shepherd of the Sea Pipe Organ

A pipe organ is being purchased for the Naval Submarine Base New London Shepherd of the Sea Chapel. The organ was built in 1956 and installed in the First Presbyterian Church, Greenwich, CT. The church is enlarging its sanctuary and will be purchasing a different organ in the future. A description of the organ is as follows: Manufactured by Austin Organs, Inc., Hartford, CT. Replacement cost, 1987 prices - $252,000.00. Cost to chapel community including purchase, renovation and installation - $60,000.00.

Government funds are not available to purchase this organ. Instead, a designated offering account within the Religious Offering Fund has been established to receive money for the organ. A Memorial Plaque will be prepared for the Dedication Service listing all gifts of $500.00 or more. The organ's installation in the Shepherd of the Sea Chapel will be in the spring of 1988.

The Shepherd of the Sea Chapel serves the entire community. Protestant and Roman Catholic Services are held weekly with a Jewish Service conducted every other month. Additionally, numerous weddings are conducted each year along with special Holy Day and Memorial Services. Special choral concerts and musical performances are performed for the enjoyment of the entire S.E. Connecticut area.

Please consider giving a gift to the SHEPHERD OF THE SEA PIPE ORGAN FUND and help to greatly enhance the Shepherd of the Sea Chapel. Gifts may be sent to the following:

Chaplains Office
Naval Submarine Base New London
Box 13
Groton, CT 06349-5013

NAVAL SUBMARINE LEAGUE
HONOR ROLL

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PRIDE RUNS DEEP

THE SUBMARINE REVIEW is a quarterly publication of the Submarine League. It is a forum for discussion of submarine matters. Not only are the ideas of its members to be reflected in the REVIEW, but those of others as well, who are interested in submarines and submarining.

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The content of articles is of first importance in their selection for the REVIEW. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the REVIEW.

A $100.00 stipend will be paid for each major article published. Although this is not a large amount, it will help offset the authors cost for paper, pen and typing. Annually, three articles are selected for special recognition and an honorarium of up to $400.00 will be awarded to the authors.

Articles should be submitted to the Editor, W. J. Ruhe, 1310 MacBeth Street, McLean, VA 22102. Discussion of ideas for articles are encouraged, phone: (703) 356-3503, after office hours.

Comments on articles and brief discussion items are welcomed to make the SUBMARINE REVIEW a dynamic reflection of the League's interest in submarines.

The success of this magazine is up to those persons who have such a dedicated interest in submarines that they want to keep alive the submarine past, help with present submarine problems and be influential in guiding the future of submarines in the U.S. Navy.

Delete

AUDIT

Naval Submarine League
Balance Sheet
at March 31, 1987

Assets:		
Cash	$85,618.31	
Furniture, equipment and software (net of depreciation)	24,372.63	
Prepaid expenses	3,098.90	
Total Assets		$113,289.84
Liabilities and Fund Balance:		
Current Liabilities:		
Deferred membership dues and contributions	$27,426.52	
Long Term Liabilities:		
Deferred membership dues and contributions	25,532.68	
Total Liabilities:		$52,959.20
Fund Balance		60,330.64
Total Liabilities and fund Balance		$113,289.84
Revenues:		
Contributions	$110,304.50	
Dues	19,311.35	
Symposium	63,751.00	
Interest	5,307.00	
Other	1,541.13	
Total Revenues		$200,214.98
Expenses:		
Awards and grants	$ 2,375.98	
Operations	86,968.53	
Publishing	37,857.15	
Meeting (Corporate Benefactors)	1,496.61	
Symposium	62,171.35	
Chapter support	2,116.00	
Total expenses		192,985.62
Excess of revenues over expenses		7,229.36
Fund balance, beginning of year		53,112.53
Less prior period adjustment		(11.25)
Fund balance, end of year		60,330.64

MEMBERSHIP STATUS

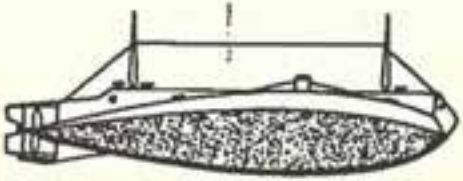
	Current	Last REVIEW	Year ago
Active Duty	898	889	791
Others	2591	2582	2285
Life	128	121	105
Student	25	24	17
Foreign	30	32	20
Honorary	12	12	6
Total	3684	3660	3224

Non-Renewal Total -- 1021

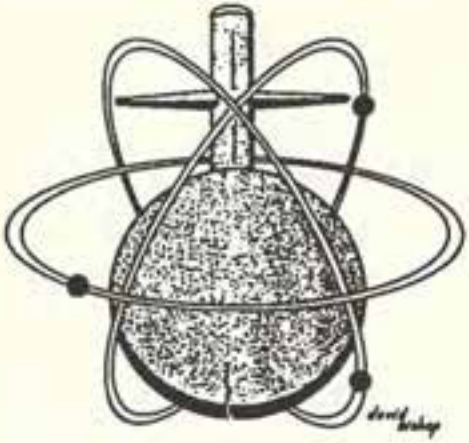
HAVE YOU GOTTEN 2 NEW MEMBERS FOR 1987?

Circulation of this issue exceeds 5,500

OHIO CLASS 1981 560 ft



UNITED STATES SUBMARINE FORCE
SINCE 1900
PRIDE RUNS DEEP



SKIPJACK Class, 1959, 252 ft

GEORGE WASHINGTON Class, 1959, 380 ft

REMEMBER

THE DATES FOR THE 1988
SIXTH ANNUAL SYMPOSIUM

are

JUNE 8-9, 1988

at the

RADISSON MARK
PLAZA HOTEL
Alexandria, Virginia

MARK YOUR CALENDARS AND
SAVE THESE DATES!